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THE

ANATOMY

OF THE

HUMAN BODY.

IN FOUR VOLUMES,

ILLUSTRATED WITH ONE HUNDRED AND TWENTY-FIVE ENGRAVINGS.

VOLUME I.

CONTAINING THE

ANATOMY

OF THE

BONES, MUSCLES, AND JOINTS.

By JOHN BELL, Surgeon.

FROM THE FOURTH LONDON EDITION, IMPROVED BY THE AUTHOR.

NEW-YORK:

PRINTED AND SOLD BY COLLINS AND CO. NO. 189,
PEARL-STREET.

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1812.

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TO

ALEXANDER WOOD,

SURGEON,

WHOSE ABILITIES, AND SKILL, AND DISINTERESTED CONDUCT,

HAVE RAISED HIM, BY COMMON CONSENT,

TO THE FIRST RANK, IN A MOST USEFUL PROFESSION,

CONDUCTING HIM, IN HONOUR, TO THAT PERIOD OF LIFE

IN WHICH HE MUST FEEL, WITH PLEASURE, HOW

COMPLETELY HE ENJOYS THE CONFIDENCE OF THE PUBLIC,

AND THE ESTEEM OF ALL GOOD MEN,

THIS BOOK OF ANATOMY IS PRESENTED BY HIS PUPIL,

JOHN BELL.

ADVERTISEMENT

To the second American Edition.

THE first American edition of this work being entirely sold, and the demand still existing and increasing, the Publishers are again induced to present the student of Anatomy with a new edition of this justly celebrated work; and while acknowledging their past success, they would express the obligations under which they are laid by the Medical Profession in general, and particularly by the Professors of Anatomy throughout the United States, for their patronage and encouragement. In Great Britain, during a short period of time, four editions of the work were printed and sold in succession, which circumstance sufficiently proves its merit; as no book, treating of so important a science, would experience such a rapid sale unless penned by professors of the greatest eminence.

A few of the numerous commendations bestowed on the work by the most respectable critics, are annexed; many more might have been added, but it is presumed these are sufficient to satisfy every reasonable enquirer.

In regard to the advantages claimed by this American edition, the publishers believe that they have on no former occasion been more successful in accomplishing the two important objects—typographical

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correctness, and great reduction in the price of the work.

With respect to the former of these advantages, the publishers can confidently claim a decided preference to the English editions. Seldom has a work been issued from the press more loaded with typographical errors, many of them of serious magnitude, than the different editions of this work, which have been published in London. Partly through the aid of a very competent medical friend, who generously offered his services to assist them, the publishers have been able to correct several hundred errors of the press. The custom of some authors in Great Britain, of submitting their manuscripts, not always very legible, entirely to the care of the printer, whose distance from their own place of residence precludes the possibility of their examining the proof-sheets, is the general, though unsatisfactory apology, offered for the numerous typographical mistakes, which are to be found in many valuable works imported from England.

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The artists who have produced these engravings, having both been regularly taught the Anatomy of the Human Body, may reasonably claim a reliance on their accuracy.

It is scarcely necessary to remark, that scrupulous care has been taken, not to omit a syllable of the letter-press nor a plate, but that the work should be presented entire.

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By Professional Critics.

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happily devised in assisting the reader to gain a full idea of the relative situation of important and complicated parts of anatomy. They add much to its sterling value, as a comprehensive and well-executed system." *Aikin's Annual Review.*

"Anatomy, in common with every other branch of natural science, has been going on with progressive improvement ever since the arrival of letters in Europe. It therefore becomes necessary from time to time, that new systems should be formed, in which the essays of different professors who have exerted themselves in perfecting the description of particular parts of the body, or in meliorating the whole, should be collected." After enumerating many celebrated anatomists who have improved the art, the reviewers conclude: "Having said thus much with regard to the great men who have laboured and are labouring to improve the art which it seemed to demand, we shall readily acknowledge that the authors have collected their materials with industry, and have enriched their work with the principal improvements in physiology, which the present age has produced." *British Critic.*

"In our account of the former part [the first two volumes by John Bell,] we bore a willing testimony to the ingenious and interesting manner in which the subject was handled. By judiciously blending the physiology, or doctrine of functions, with the anatomical descriptions, by frequent occasional references to pathology and practice, and by a manner peculiarly impressive and interesting, he was enabled to excite the attention of the student to a subject of the first importance to the healing art, but one which is rendered dry and disgusting by the ordinary mode of treating it. The latter volumes by Mr. Charles Bell, are respectably executed; and together they form a body of anatomy, greatly superior to any at present to be found in our language."

London Medical and Chirurgical Review.

The editors of the *New-York Medical Repository*, thus announce the first American edition.

"Our readers we are confident will universally participate the pleasure we feel in announcing that Messrs. Collins & Perkins

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The editors of the *New-York Medical and Philosophical Journal and Review*, in announcing the same undertaking, dwell on the great importance to the profession of thus reducing the prices of imported books, and proceed as follows:

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The editor of the *Philadelphia Medical Museum*, has called the attention of his readers to the same subject, and informed them, that

"This highly useful and important work is to be printed in two volumes, 8vo. on a fine vellum paper, from the fourth London edi-

tion. A selection of reviews from English publications accompanies the prospectus, which cannot fail of evincing the high degree of estimation in which this interesting work is held; and as it is given at less than half the price of the English edition, must ensure the sanction of the Physicians of America, as a work in the highest degree worthy of a place in every medical library."

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COLLINS & CO. announce to the Medical Profession, that they have been induced to turn their attention to the sale of

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PREFACE.

TO those who are at all acquainted with books on anatomy, the appearance of a new one on the subject will not be surprising: to those who are not yet acquainted with such writings, I have only to say that I have written this book, because I believed that such a one was needed, and must be useful. I have endeavoured to make it so plain and simple as to be easily understood; I have avoided the tedious interlarding of technical terms (which has been too long the pride of anatomists and the disgrace of their science), so that it may read smoothly compared with the studied harshness, and, I may say, obscurity, of anatomical description. If an author may ever be allowed to compare his book with others, it must be in the mechanical part; and I may venture to say, that this book is full and correct in the anatomy, free and general in the explanations, not redundant, I hope, and yet not too brief.

If, in the course of this volume, I shall appear to have given to theories a place and importance far higher than they really deserve, my reader will naturally feel how useful they are in preserving the due balance between what is amusing and what is useful; between the looser doctrines of functions and the close demonstration of parts. He will be sensible how much more easily these things can be read in the closet than taught in any public course; he will, I think, be ready to

acknowledge, that I introduce such theories only as should connect the whole, and may be fairly distinguished as the physiology of facts; and he will perceive, that in this, too, I feel a deference for the public opinion, and that respect for the established course of education which it is natural to feel and to comply with.

Thus, perhaps, it is less immodest for an author to put down what he thinks he may honestly say concerning his own book, than to omit those apologies which custom requires; which give assurance that he has not entered upon his task rashly, nor performed it without some labour and thought; which are the truest signs of his respect for the Public, and of his care for that science to which he has devoted his life.

With these intentions and hopes I offer this book to the Public; and more particularly to those in whose education I have a chief concern: not without a degree of satisfaction at having accomplished what, I think, cannot fail to be useful; and surely not without an apprehension of not having done (in this wide and difficult subject) all that may be expected or wished for.

Every book of this kind should form a part of some greater system of education: it should not only be entire in its own plan, but should be as a part of some greater whole; without which support and connection a book of science is insulated and lost. This relation and subserviency of his own particular task to some greater whole, is first in an author's mind: he ventures to look forward to its connection with the general science and common course of education; or he turns it to a correspondence and harmony with his own notions of study: and if these notions are to give the complexion and character to any book, it should be when it is designed for those who are entering upon their studies, as yet uncertain where to begin, or how to proceed.

Hardly any one has been so fortunate as to pursue the study of his own science under any regular and perfect plan; and there are very few with whom a consciousness of this does not make a deep and serious impression at some future period, ac-

companied with severe regret for the loss of time never to be retrieved. In medicine, perhaps, more than in any other science, we begin our studies thoughtless and undecided, following whatever is delightful (as much is delightful), and neglecting the more severe and useful parts: but as we advance towards that period in which we are to enter upon a most difficult profession, and to take our place and station in life; and when we think of the hesitation, anxiety, and apprehension, with which we must move through the first years of practice—we begin to look back with regret on every moment that is past; with a consciousness of some idle hours; and (what is more afflicting still) with an unavailing sense of much ill-directed, unprofitable labour:—for there is no study upon which a young man enters with a more eager curiosity; but not instructed in what is really useful, nor seriously impressed with the importance of his future profession, he thinks of his studies rather as the amusement, than as the business, of life; slumbers through his more laborious and useful tasks, and soon falls off to the vain pursuit of theories and doctrines.

If I were not persuaded of the important consequences, of the infinite gain or loss which must attend the first steps, in every profession, I should not feel, but, above all, I should not venture to express, an anxiety, which may be thought affected by those who cannot know how sincere it must be; for, in our profession, this is the course of things, that a young man, who, by his limited fortune, or the will of his friends, by absence from his native country, or by the destination of his future life, is restricted to a few years of irregular, capricious, ill-directed study, throws himself at once into the practice of a profession, in which, according to his ignorance or skill, he must do much good or much harm. Here there is no time for his excursions into that region of airy and fleeting visions, and for his returning again to sedate and useful labour there is no time for his discovering, by the natural force of his own reason, how vain all speculations are.—In but a few years, at most, his education is determined; the limited term is completed ere he have learnt that most useful of all lessons,

the true plan of study; and his opportunities come to be valued (like every other happiness), only when they are lost and gone.

Of all the lessons which a young man entering upon our profession needs to learn, this is, perhaps, the first,—that he should resist the fascinations of doctrines and hypotheses, till he have won the privilege of such studies by honest labour, and a faithful pursuit of real and useful knowledge. Of this knowledge, anatomy surely forms the greatest share.—Anatomy, even while it is neglected, is universally acknowledged to be the very basis of all medical skill.—It is by anatomy that the physician guesses at the seat, or causes, or consequences, of any internal disease.—Without anatomy, the surgeon could not move one step in his great operations; and those theories could not even be conceived, which so often usurp the place of that very science, from which they should flow as probabilities and conjectures only, drawn from its store of facts.

A consciousness of the high value of anatomical knowledge never entirely leaves the mind of the student. He begins with a strong conviction that this is the great study, and with an ardent desire to master all its difficulties: if he relaxes in the pursuit, it is from the difficulties of the task, and the seduction of theories too little dependent on anatomy, and too easily accessible without its help. His desire for real knowledge revives only when the opportunity is lost; when he is to leave the schools of medicine; when he is to give an account of his studies with an anxious and oppressed mind, conscious of his ignorance in that branch which is to be received as the chief test of his professional skill; or when, perhaps, he feels a more serious and manly impression, the difficulty and importance of that art which he is called to practise.

Yet, in spite of feeling and reason, the student encourages in himself a taste for speculations and theories, the idle amusements of the day, which, even in his own short course of study, he may observe sinking in quick succession into neglect and oblivion, never to revive; he aspires to the character of a physiologist, to which want of experience, and a youthful

fancy, have assigned a rank and importance which it does not hold in the estimation of those who should best know its weakness or strength. The rawest student, proud of his physiological knowledge, boasts of a science and a name which is modestly disclaimed by the first anatomist, and the truest physiologist of this or any age. Dr. Hunter speaks thus of his physiology, and of his anatomical demonstration: "Physiology, as far as it is known, or has been explained by Haller, "and the best of the moderns, may be easily acquired by a "student without a master, provided the student is acquainted "with philosophy and chemistry, and is an expert and ready "anatomist; for with these qualifications he can read any "physiological book, and understand it as fast as he reads.

"In this age, when so much has been printed upon the subject, there is almost as little inducement to attend lectures "upon physiology, as there would be for gentlemen to attend "lectures upon government, or upon the history of England. "Lectures upon subjects which are perfectly intelligible in "print, cannot be of much use, except when given by some "man of great abilities, who has laboured the subject, and "who has made considerable improvements either in matter "or in arrangement.

"In our branch, those teachers who take but little pains to "demonstrate the parts of the body with precision and clearness, but study to captivate young minds with ingenious "speculation, will not leave a reputation that will outlive them "half a century.

"I always have studied, and shall continue my endeavours, "to employ the time that is given up to anatomical studies as "usefully to the students as I can possibly make it—and therefore shall never aim at showing what I know, but labour to "show and describe, as clearly as possible, what they ought to "know. This plan rejects all declamation, all parade, all "wrangling, all subtility: to make a show, and to appear "learned and ingenious in natural knowledge, may flatter "vanity; to know facts, to separate them from suppositions,

" to range and connect them, to make them plain to ordinary " capacities, and, above all, to point out the useful applica- " tions—is, in my opinion, much more laudable, and shall be " the object of my ambition*."

* Introductory Lecture published by Dr. Hunter.

EDINBURGH,
SEPT. 1793.

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THE

ANATOMY

OF THE

BONES, MUSCLES, AND JOINTS.

BOOK I.

OF THE BONES.

CHAP. I.

OF THE FORMATION AND GROWTH OF BONES.

IT is not easy to explain, in their natural order, the various parts of which the human body is composed; for they have that mutual dependence upon each other, that continual circle of action and re-action in their various functions, and that intricacy of connection, and close dependence, in respect to the individual parts, that, as in a circle there is no point of preference from which we should begin to trace its course, so in the human body there is no function so insulated from the other functions, no part so independent of other parts, as to determine our choice. We cannot begin without hesitation, nor hope to proceed in any perfect course; yet, from whatever point we begin, we may so return to that point, as to represent truly this consent of functions, and connection of parts, by which it is composed into one perfect whole.

The bones are framed as a basis for the whole system; fitted to support, defend, and contain the more delicate and noble organs. They are the most permanent and unchangeable of all parts of the body. We see them exposed to the seasons, without suffering the smallest change; remaining for ages the memorials of the dead; the evidence of a former race of men exceeding ours in strength and stature; the only remains of creatures which no longer exist; the proofs of such changes on our globe, as we cannot trace but by these uncer-

tain marks. Thus we are apt to conceive, that even in the living body, bones are hardly organized; scarcely partaking of life; not liable, like the soft parts, to disease and death. But minute anatomy, the most pleasing part of our science, unfolds and explains to us the internal structure of the bones; shows their myriads of vessels; and proves them to be as full of blood as the most succulent and fleshy parts; having, like them, their periods of growth and decay; being as liable to accidents, and as subject to internal disease.

The phenomena of fractured bones first suggested some indistinct notions of the way in which bone might be formed. It was observed, that in very aged men, a hard crust was often formed upon the surface of the bones; that the fluid exuding into the joints of gouty people, sometimes coagulated into a chalky mass; Le Dran had seen in a case of spina ventosa, or scrophulous bone, an exudation which flowed out like wax, and hardened into perfect bone; Daventer had seen the juice that exuded from a split in a bone, coagulate into a bony crust; and it was thought to be particularly well ascertained, that callus was but a coagulable juice, which might be seen exuding directly from the broken ends of a bone, and which gradually coagulated into hard bone. The best physiologists did not scruple to believe, that bones, and the callus of broken bones, were formed of a bony juice, which was deposited by the vessels of the part, and which passing through all the successive conditions of a thin uncoagulated juice, of a transparent cartilage, and of soft and flexible bone, became at last, by a slow coagulation, a firm, hard, and perfect bone; depending but little upon vessels or membranes, either for its generation or growth, or for nourishment in its perfect state. But this coagulation is a property of dead matter, which has no place in the living system; or if blood or mucus do ever coagulate within the body, it is only after it is separated from the system. Coagulation is a sort of accident in the living body; and it is not to be believed that the accidental concourse of parts should form the perfect system of a living bone; nor that coagulation, an irregular uncertain process, should keep pace with the growth of the living parts; that a bone which is completely organized, and a regular part of the living system, should, in all its progress towards this perfect state, be merely inanimate, inorganized matter: yet this opinion once prevailed; and if other theories were at that time proposed, they did not vary in any very essential point from this first notion. De Heide, a surgeon of Amsterdam, believed that bone or callus was not formed from a coagulable juice, but from the blood itself. He broke the bones of ani-

mals, and, examining them at various points of time, he never failed (like other speculators) to find exactly what he desired to find. In "every experiment," he found a great effusion of blood among the muscles, and round the broken bone: and he as easily traced this blood through all the stages of its progress: on the first day red and fluid; by and by coagulated; then gradually becoming white, then cartilaginous, and at last (by the exhalation of its thinner parts) hardening into perfect bone.

It is very singular, that often those who abjure theory, and appeal to experiments, who profess only to deliver facts, are least of all to be trusted; for it is theory which brings them to try experiments, and then the form and order; and even the result of such experiments, must bend to meet the theories which they were designed to prove. It is by this deception that the authors of two rival doctrines arrive at opposite conclusions by facts directly opposed to each other. Du Hamel believed, that as the bark formed the wood of a tree, adding, by a sort of secretion, successive layers to its growth; so the periosteum formed the bone at the first, renewed it when spoiled or cut away, and, when broken, assumed the nature of bone, and repaired the breach. He broke the bones of pigeons, and, allowing them to heal, he found the periosteum to be the chief organ for reproducing bone. He found that the callus had no adhesion to the broken bone, and was easily separated from the broken ends which remained rough and bare. And, in pursuing these dissections, he found the periosteum fairly glued to the external surface of the new bone; or he found rather the callus or regenerated bone to be but a mere thickening of the periosteum, its layers being separated, and its substance swelled. On the first days he found the periosteum thickened, inflamed, and easily divided into many lamellæ, or plates; but while the periosteum was suffering these changes, the bone was in no degree changed. On the following days, he found the tumour of the periosteum increased at the place of the fracture, and extending further along the bone; its internal surface already cartilaginous, and always tinged with a little blood, which came to it through the vessels of the marrow. He found the tumour of the periosteum spongy, and divisible into regular layers, while still the ends of the bone were unchanged, or only a little roughened by the first layer of the periosteum being already converted into earth and deposited upon the surface of the bone; and in the next stage of its progress, he found the periosteum firmly attached to the surface of the callous mass. By wounding, not breaking, the bones, he had still a more flattering ap-

pearance of a proof; for having pierced them with holes, he found the holes filled up with a sort of tompion, proceeding from the periosteum, which was thickened all round them. In an early stage, this plug could, by drawing the periosteum, be pulled out from its hole: in a more advanced stage, it was inseparably united to the bone, so as to supply the loss.

Haller, doubting whether the periosteum, a thin and delicate membrane, could form so large a mass of bone or callus, repeated the proofs; and he again found quite the reverse of all this: that the callus, or the original bone, was in no degree dependent on the periosteum, but was generated from the internal vessels of the bone itself: that the periosteum did indeed appear as early as the cartilage which is to produce the bone, seeming to bound the cartilage, and give it form; but that the periosteum was at first but a loose tissue of cellular substance, without the appearance of vessels, or any mark of blood, adhering chiefly to the heads or processes, while it hardly touched the body of the bone. He also found that the bone grew, became vascular, had a free circulation of red blood, and that then only the vessel of the periosteum began to carry red blood, or to adhere to the bone. We know that the bones begin to form in small nuclei, in the very centre of their cartilage, or in the very centre of the yet fluid callus, far from the surface, where they might be assisted by the periosteum; and that ossification begins first in the middle of the long bones, where the periosteum does not adhere, and is formed much later in the heads and processes, whose connection with the periosteum is very close.

Thus has the formation of bone been falsely attributed to a gelatinous effusion, gradually hardened; or to that blood which must be poured out from the ruptured vessels round a fractured bone; or to the induration and change of the periosteum, depositing layer after layer, till it completed the form of the bone.

But when, neglecting theory, we set ourselves to examine, with an unbiassed judgment, the process of nature in forming the bones, as in the chick, or in restoring them, as in broken limbs, a succession of phenomena present themselves, the most orderly, beautiful, and simple, of any that are recorded in the philosophy of the animal body: for if bones were but condensed gluten, coagulated blood, or a mere deposition from the periosteum, they were then inorganized, and out of the system, not subject to change, nor open to disease; liable, indeed, to be broken, but without any means of being healed again: while they are, in truth, as fully organized, as permeable to the blood, as easily hurt, and as easily healed, as

sensible to pain, and as regularly changed as the softer parts are. We are not to refer the generation and growth of bone to any one part. It is not formed by that gelly in which the bone is layed; nor by the blood which is circulating in it; nor by the periosteum which covers it; nor by the medullary membrane with which it is lined: but the whole system of the bone, of which these are parts only, is designed and planned, is laid out in the very elements of the body, and advances to ripeness by the concurring action of all its parts. The arteries, by a determined action, deposite the bone; which is formed commonly in a bed of cartilage, as the bones of the leg or arm are; sometimes betwixt two layers of membrane, like the bones of the skull, where true cartilage is never seen. Often the secretion of the bony matter is performed in a distinct bag, and there it grows into form, as in the teeth; for each tooth is formed in its little bag, which, by injection, can be filled and covered with vessels. Any artery of the body may assume this action, and deposite bone, which is sometimes also formed where it should not be; in the tendons and in the joints, in the great arteries, and in their valves, in the flesh of the heart itself, or even in the soft and pulpy substance of the brain.

All the bones of the body, both in the human fœtus, and in other animals, are merely cartilage before the time of birth. The whole fœtus is gelatinous; the bones are a pure, almost transparent and tremulous gelly; they are flexible, so that a long bone can be bent into a complete ring; and no opacity, nor spot of ossification is seen.

This cartilage is never hardened into bone; but, from the first, it is in itself an organized mass. It has its vessels; which are at first transparent, but which soon dilate, and whenever the red colour of the blood begins to appear in them, ossification very quickly follows, the arteries being so far enlarged as to carry the coarser parts of the blood. The first mark of ossification is an artery, which is seen running into the centre of the gelly in which the bone is to be formed. Other arteries soon appear; overtake the first; mix with it, and form a net-work of vessels; then a centre of ossification begins, stretching its rays according to the length of the bone, and then the cartilage begins to grow opaque, yellow, brittle; it will no longer bend, and the small nucleus of ossification is felt in the centre of the bone, and when touched with a sharp point, is easily known by its gritty feel. Other points of ossification are successively formed; the ossification being always foretold by the spreading of the artery, and by the arrival of red blood. Every point of ossification has its little arteries,

and each ossifying nucleus has so little dependence on the cartilage in which it is formed, that it is held to it by these arteries only; and when the ossifying cartilage is cut into thin slices, and steeped in water till its arteries rot, the nucleus of ossification drops spontaneously from the cartilage, leaving the cartilage like a ring, with a smooth and regular hole where the bone lay.

The colour of each part of a bone is proportioned exactly to the degree in which its ossification has advanced. When ossification begins in the centre of the bone, redness also appears; indicating the presence of those vessels by which the bony matter is to be poured out. When the bony matter begins to accumulate, the red colour of those arteries is obscured, the centre of the bone becomes yellow or white, and the colour seems be removed towards the ends of the bone. In the centre, the first colouring of the bone is a cloudy, diffused and general red, because the vessels are profuse. Beyond that, at the edges of the first circle, the vessels are more scattered, and distinct trunks are easily seen, forming a circle of radiating arteries, which point towards the heads of the bone. Beyond that, again, the cartilage is transparent and pure, being yet untouched with blood; the arteries have not reached it, and its ossification is not begun. Thus, a long bone, while forming, seems to be divided into seven variously coloured zones. The central point of most perfect ossification is yellow and opaque. On either side of that, there is a zone of red. On either side of that again, the vessels being more scattered, form a vascular zone,* and the zone at either end is transparent or white. The ossification follows the vessels, burying and hiding those vessels by which it is formed: the yellow and opaque part expands and spreads along the bone: the vessels advance towards the heads of the bones: the whole body of the bone becomes opaque, and there is left only

* It is curious to obſerves how completely vaſcular the bone of a chicken is before the oſſification have fairly begun; how the oſſification having begun, overtakes the arteries, and hides them, changing the tranſparent and vaſcular part of the bone into an opaque white; how, by peeling off the perioſteum, bloody dots are ſeen, which ſhows a living connection and commerce of veſſels betwixt the perioſteum and the bone; how, by tearing up the outer layers of the tender bone, the vaſcularity of the inner layers is again expoſed. But of all the proofs of the vaſcularity of bones and depoſition of the bony matter, the moſt beautiful is that of our common preparations; where, after filling with injection the arteries of an adult bone, by its nutritious veſſels, we, by corroding the bone with mineral acids, diſſolve the earth, leaving nothing but the tranſparent gelly, and thus reſtore the bone to its original cartilaginous ſtate; then the veſſels appear in ſuch profuſion, that the bone may be compared in vaſcularity with the ſoft parts, and it is ſeen that its arteries were not annihilated, but its high vaſcularity only concealed by the depoſition of the bony parts.

a small vascular circle at either end: the heads are separated from the body of the bone by a thin cartilage; and the vessels of the centre, extending still towards the extremities of the bone, perforate that cartilage, pass into the head of the bone, and then its ossification also begins, and a small nucleus of ossification is formed in its centre. Thus the heads and the body are, at the first, distinct bones formed apart and joined by a cartilage; and they are not united till the age of fifteen or twenty years.

The vessels are seen entering in one large trunk (the nutritious artery) into the middle of the bone: from that centre they extend in a radiated form towards either end, and the fibres of the bone are radiated in the same direction; there are furrows betwixt the rays, and the arteries run along in the furrows of the bone, as if the arteries were forming these ridges, secreting and pouring out the bony matter, each artery piling it up on either side to form its ridge. The body of the bone is supplied by its own vessels; the heads of the bone are supplied by the extremities of the same trunks which perforate the dividing cartilage like a sieve; the periosteum adhering more firmly to the heads of the bone, it brings assistant arteries from without, which meet the internal trunks, and assist the ossification; but with every help, the ossification is not accomplished in many years.

It is by the action of the vessels that all the parts of the human body are formed; fluids and solids, each for its respective use. The blood is formed by the action of the vessels, and all the fluids are in their turn formed from the blood. We see in the chick, where there is no external source from which its red blood can be derived, that red blood is formed within its own system. Every animal system, as it grows, assimilates its food, and converts it to the animal nature, and so increases the quantity of its red blood: and as the red blood is thus prepared by the actions of the greater system, the actions of particular vessels prepare various parts: some to be added to the mass of solids, for the natural growth; others to supply the continual waste; others to be discharged from the body as effete, and hurtful, or to allow new matter to be received; others again to perform certain offices within the body, as the secretion of semen, of saliva, of bile, or of urine. Thus the body is furnished with various apparatus for performing various offices, and for repairing the waste. These are the secretions, and the formation of bone is one of these. The plan of the whole body lies in the embryo, in perfect order, with all its forms and parts. Cartilage is laid in the place of bone, and preserves its form for the future bone, with all its appara-

tus of surrounding membranes, its heads, its processes, and its connection with the soft parts. The colourless arteries of this pellucid, but organized mass of cartilage keep up its growth; extend, and yet preserve its form; and gradually enlarging in their own diameter, at last receive the entire blood. Then the deposition of earthy matter begins. The bone is deposited in specks, which spread and meet, and form themselves into perfect bone. While the bone is laid by arteries, the cartilage is conveyed away by the absorbing vessels; and while they convey away the superfluous cartilage, they model the bone into its due form; shape out its cavities, cancelli, and holes; remove the thinner parts of the cartilage, and harden it into due consistence.

If such organization of arteries to deposite bone, and of absorbents to take up the cartilage and make room for the osseous matter, be necessary in the formation and growth, it is no less necessary for the life and health of the full-formed bone. Its health depends on the regular deposition and re-absorption, moulding and forming the parts; and by various degrees of action, bone is liable to inflame, to ulcerate, to rot and spoil, to become brittle by too much secreted earth, or to become soft by a greedy diseased absorption of its earthy parts. The earth, which constitutes the hardness, and all the useful properties of bone, is dead, inorganized, and lies in the interstices of the bone; where it is united with mucus, to give it consistence and strength; furnished with absorbents to keep it in health, and carry off its wasted parts; and pervaded by vessels to supply it with new matter. The cartilage is itself a secretion, to which the full secretion of bone succeeds, as the arteries grow stronger in their secreting office: for in a broken limb there is first a thin effusion, then a tremulous gelly, then radiated vessels, then ossifying spots, and these running together form perfect bone. If the broken limb be too much moved during the cure, then the secreting arteries are interrupted in their office; perfect bone is never formed; it remains a cartilage; and an unnatural joint is produced: but we cut the surface of these cartilages, and then the vessels are opened again, the process is renewed, and the bones unite: or even by rubbing, by stimulating, by merely cutting the surrounding parts, the vessels are made active, and their secretion is renewed. During all the process of ossification, the absorbents proportion their action to the stimulus which is applied to them; they carry away the serous fluid, when gelly is to take its place; they remove the gelly, as the bone is laid; they continue removing the bony particles also, which (as in a circle) the arteries continually renew.

Nothing can be more curious than this continual renovation and change of parts, even in the hardest bones. We are accustomed to say of the whole body, that it is daily changed; that the old particles are removed; and new ones supply their place; that the body is not now the same individual body that it was; but it could not be easily believed that we speak only by guess concerning the softer parts, what we know for certain of the bones. It was discovered by chance, that animals fed upon the refuse of the dyer's vats, received so much of the colouring matter into the system, that the bones were tinged by the madder to a deep red, while the softer parts were unchanged; no tint remaining in the ligaments nor cartilages; in the membranes, vessels, nor nerves; not even in the delicate vessels of the eye. It was easy to distinguish by the microscope, that such colour was mixed with the bony matter, and resided in the interstices only, but did not remain in the vessels of the bone, which like those of all the body had no tinge of red; while our injections again fill the vessels of the bone, make all their branches red, but do not affect the colours of the bony part. When madder is given to animals, withheld for some time, and then given again, the colour appears in their bones; is removed; and appears again, with such a sudden change as proves a rapidity of deposition and absorption exceeding all likelihood or belief. All the bones are tinged in twenty-four hours: in two or three days their colour is very deep: and if the madder be left off but for a few days, the red colour is entirely removed.

This tinging of the bones with madder, was the great instrument employed by Du Hamel, for proving by demonstration, that it was by layers from the periosteum that the bone was formed; and how very far the mind is vitiated by this vanity of establishing a doctrine on facts, is too easily seen here. As Du Hamel believed that the periosteum deposited successive layers, which were added to the bone, it was his business to prove that the successive layers would be deposited alternately red, white, and red again, by giving a young animal madder, withholding it for a little while, and then beginning again to give it. Now, it is easy to foresee that this tinging of the lamellæ should correspond with the successive times in which the periosteum is able to deposite the layers of its substance; but Du Hamel very thoughtlessly makes his layers correspond only with the weeks or months in which his madder was given or withheld. It is easy to foresee also, that if madder be removed from the bones in a few days (which he himself has often told us,) then his first layer, viz. of red bone, could not have waited for his layer of white to

be laid above it, nor for a layer of red above that again, so as to enable him to show successive layers: and if madder can so penetrate, as to tinge all the bones that are already formed, then, though there might be first a tinged bone, then a white and colourless layer, whenever he proceeded to give madder for tinging a third layer, it would pervade all the bone, tinge the layer below, and reduce the whole to one tint. If a bone were thus to increase by layers, thick enough to be visible, and of a distinct tint; and if such layers were to be continually accumulated upon each other every week, what kind of a bone should this grow to? Yet such is the fascinating nature of a theory, that Du Hamel, unmindful of any interruptions like these, describes boldly his successive layers; carrying us through regular details, experiment after experiment, till at last he brings up his report to the amount of five successive layers, viz. two red layers, and three white ones: nay, in one experiment he makes the tinge of the madder continue in the bones for six months, forming successive layers of red and white; although, in an earlier experiment (which he must have forgotten in his hurry,) he tells us, that by looking through the transparent part of a cock's wing, he had seen the tinge of the madder gradually leave the bones in a few days.

These experiments are as gross and palpable as the occasion of them; and should stand as a warning to us, showing how severely and honestly we ought to question our own judgment, when we aim at confirming our preconceived theories by experiments and facts.

Yet by these experiments with madder, one most important fact is proved to us; that the arteries and absorbents, acting in concert, alternately deposite and reabsorb the earthy particles, as fast as can be conceived of the soft parts, or even of the most moveable and fluctuating humours of the body. The absorption of the hardest bones is proved by daily observation. When a carious bone disappears before the integuments are opened; when a tumour, pressing upon a bone, destroys it; when an aneurism of the temporal artery destroys the skull; when an aneurism of the heart beats open the thorax, destroying the sternum and ribs; when an aneurism of the ham destroys the thigh-bone, tibia, and joint of the knee; when a tumour coming from within the head, forces its way through the bones of the skull;—in all these cases, since the bone cannot be annihilated, what can happen, but that it must be absorbed and conveyed away? If we should need any stronger proofs than these, we have mollities ossium; a disease by which, in a few months, the bony system is entirely

broken up, and conveyed away, by a high action of the absorbents, with continual and deep-seated pain, a discharge of the earthy matter by the urine, and a gradual softening of the bones, so that they bend under the weight of the body; the heels are turned up behind the head; the spine becomes crooked; the pelvis distorted; the breast is crushed and bent in: and the functions beginning to fall low, the patient, after a slow hectic fever, long and much suffering of pain and misery, expires; with all the bones distorted in a shocking degree; gelatinous, or nearly so, robbed of all their earthy parts; and so thoroughly softened that they may be cut with the knife.

Thus every bone has, like the soft parts, its arteries, veins, and absorbent vessels. And every bone has its nerves too: we see them entering into its substance in small threads, as on the surfaces of the frontal and parietal bones; we see them entering for particular purposes, by a large and peculiar hole, as the nerves which go into the jaws to reach the teeth: we find delicate nerves going into each bone along with its nutritious vessels; and yet we dare hardly believe the demonstration, since bones seem quite insensible and dead. We have no pain when the periosteum is rasped and scraped from a bone: we have no feeling when bones are cut in amputation; or when, in a broken limb, we cut off with pincers the protruding end of a bone; we feel no pain when a bone is trepanned, or when caustics are applied to it; and it has been always known, that the heated irons which the old surgeons used so much, made no other impression upon the bone than to excite a particular titillation and heat, rather pleasant than painful, running along the course of the bone. But there is a deception in all this. A bone may be exquisitely sensible, and yet give no pain; a paradox which is very easily explained. A bone may feel acutely, and yet not send its sensation to the brain. It is not fit that parts should in this sense feel, which are so continually exposed to shocks and blows, and all the accidents of life; which have to suffer all the motions which the other parts require. In this sense, the bones, the cartilages, ligaments, bursæ, and all the parts that relate to joints, are quite insensible and dead. A bone does not feel, or its feelings are not conveyed to the brain; but with this single exception, it shows every mark of life. Scrape a bone, and its vessels bleed; cut or bore a bone, and its granulations sprout up; break a bone, and it heals; or cut a piece of it away, and more bone will be readily produced; hurt it in any way, and it inflames; burn it, and it dies: take any proof of sensibility, but the mere feeling of pain, and it will answer

to the proof. In short, these parts have a sensibility which belongs to themselves, but have no feelings in correspondence with the general system.

A bone feels stimuli, and is excited to re-act; injuries produce inflammation in the bones, as in the soft parts; and then swelling and spongy looseness, and a fullness of blood, suppuration, ulcer, and the death and discharge of the diseased bone ensue. When the texture of a bone is thus loosened by inflammation, its feeling is roused; and the hidden sensibility of the bone rises up like a new property of its nature: and as the eye, the skin, and all feeling parts, have their sensibility increased by disease, the bones, ligaments, bursæ, and all the parts whose feeling, during health, is obscure and hardly known, are roused to a degree of sensibility far surpassing the soft parts. The wound of a joint is indeed less painful at first, but when the inflammation comes, its sensibility is raised to a dreadful degree: the patient cries out with anguish. No pains are equal to those which belong to the bones and joints.

Thus ossification is a process of a truly animal nature: no coagulation will harden cartilage into bone; no change of consistency will convert the blood into it; no condensation of the periosteum can assimilate it to the nature of a bone. Bone is not the inorganic concrete which it was once supposed; but it is a regularly organized part, whose form subsists from the first; and which is perfected by its secreting arteries, balanced, as in every secretion, by the absorbents of the part: it lives, grows and feels; is liable to accidents, and subject to disease. It is a process which, at first, appears so rapid, that we should expect it to be soon complete; but it becomes in the end a slow and difficult process. It is rapid at first; it advances slowly after birth; it is not completed in the human body till the twentieth year; it is forwarded by health and strength, retarded by weakness and disease. In scrofula it is imperfect; and so children become rickety, the bones softening and swelling at their heads, and bending under the weight of the body. And why should we be surprised, that carelessness of food or clothing, bad air, or languid health, should cause that dreadful disease, when more or less heat, during the incubation of a chick, affects the growth of its bones; when the sickness of a creature, during our experiments, protracts the growth of callus; when, in the accidents of pregnancy, of profuse suppuration, or of languid health, the knitting of broken bones is delayed, or wholly prevented.

This process, so difficult and slow, is assisted by every provision of nature. The progress of the whole is slow, that as

long as the body increases in stature, the bones also may grow; but it is assisted in the individual parts, where some are slow; some rapid in their growth; some delayed, as the heads of joints, that their bones may be allowed to extend; and others hastened, as the pelvis, that they may acquire their perfect size early in life. Ossification is assisted by the softness of the cartilaginous bed in which the bone is formed; by those large and permeable vessels which carry easily the grosser parts of the blood; by a quick and powerful absorption, which all along is modelling the bone; and, most of all, by being formed in detached points, multiplied and crowded together, wherever much bone is required.

There is one central ring first ossified in a long bone, as of the leg or arm; the heads or ends of the bone are at first mere cartilage, but they also soon begin to ossify; the body stretches in a radiated form towards either head; the heads ossifying each in its centre, also stretch towards the bone; the heads meet the body, and join to it; a thin cartilage only is interposed, which grows gradually thinner till the twentieth year, and then disappears; the body, heads, and processes, becoming one bone. In flat bones, as in the skull, ossification goes from one or more central points, and the radiated fibres meet the radii of other ossifying points, or the edges of the next bone. The thick round bones which form the wrist and foot, have one ossification in their centre, which is bounded by cartilage all round. The processes are often distinct ossifications joined to the bones, like their heads, and slowly consolidated with them into firm bones.*

While the bone is forming, various parts, essential to its system, gradually rise into view. At first, we cannot in the long bone perceive any heads, processes, cavities, or cells; these parts are very slowly formed, and are perfected only in the adult bone.

At first, the whole length of a long bone is represented by a transparent gelly; where there is no distinction of heads nor processes, it is all of one mass. After the red blood has begun to tinge this cartilage, the ossification begins, and one ring is formed in the middle of the bone: from this ring, the fibres stretch towards either end, and stop there; then it begins to appear that the heads and body are distinct parts; the fibres of the growing bone have extended till the cartilage is annihilated, and only a small plate remains, separating the knobs of the heads from the long body of the bone. Thus, there is no distinction betwixt the heads and the body, while the bone is

* The processes and heads are named the epiphysis and apophysis of bones.

cartilaginous ; they begin to appear, as distinct parts, at that stage in which the body of the bone is ossified, and each of the heads is beginning to form : they continue three distinct bones, during all the early part of life, and are easily separated, by soaking the bone in water ; when they are separated, there is seen a rough hollow on the surface of the epiphysis, or separated head, and a rough convexity on the end of the body : they are finally united into one bone, about the twentieth year.

In the original cartilage, there is no hollow, nor cavity ; it is all one solid mass. When the ossification first appears, the cavity of the bone also begins, and extends with the ossification. At first, the cavity is confined chiefly to the middle of the bone, and extends very slowly towards the ends. This cavity, in the centre of the bone, is at first smooth, covered by an internal membrane, containing the trunks and branchings of the nutritious vessels, which enter by a great hole, in the middle of the bone ; and the cavity is traversed, with divisions of its lining membrane, which, like a net-work of partitions, conduct its branches to all parts of the internal surface of the bone ; and its nets, or meshes, are filled with a reddish and serous fluid, in the young bone, but secrete and contain a perfect marrow in the adult bone.

The whole substance of a bone is not only fibrous, as appears outwardly, but is truly lamellated, consisting of many distinct and delicate plates of bone ; which lie over each other in regular order, and might suggest the notion that successive ossifications of the periosteum form the bone. These lamellæ, or plates, are more condensed and firmer towards the outer surface ; and are more loose, separate, and spongy, towards the internal surface of the bone : and it is easily seen, during the growth of a young bone, that the inner and more delicate plates are separating from the walls of the bone, and receding towards its cavity ; and these plates, being again crossed by small bony partitions, form a net-work, or spongy mass, which fills the whole cavity of the bone. In the middle of the bone, the cavity is small, the walls are thick, and have all their bony plates ; the cells of net-work are few, and large : but towards the ends, the bone swells out ; the cavity also is large, but it is not like that in the middle, a large tubular cavity ; it is so crossed with lattice-work, with small interstices and cells, that it seems all one spongy mass of bone ; and so many of the inner layers are separated, to form this profusion of cells, that the whole substance of the bone has degenerated into this

lattice-work, leaving only a thin outward shell.* This reticular form is what anatomists call the cancelli, lattice-work, net-work, or alveolar part of the bone : it is lined throughout with one delicate membrane ; and inward partitions of the same lining membrane cover each division of the lattice-work, forming each cell into a distinct cavity. In these cavities or cells the marrow is secreted. The secretion is thin and bloody in children ; it thickens as we advance in years ; it is a solid oil, or marrow, in the adult. The marrow is firmer, and more perfect in the middle of the bone ; more thin and serous towards the spongy ends. The whole mass, when shaken out of the bone, is like a bunch of grapes, each hanging by its stalk. The globules, when seen with the microscope, are neat, round, and white, seeming like small pearls, and each stalk is seen to be a small artery, which comes along the membrane of the cancelli, spreads its branches beautifully on the surface of the bag, and serves to secrete the marrow, each small twig of artery filling its peculiar cell. To this, an old anatomist added, that they had their contractile power, like the urinary bladder, for expelling their contents ; that they squeezed their marrow, by channels of communication, through and among the bony layers ; and that their oil exuded into the joint, by nearly the same mechanism by which it got into the substance of the bone.

While the constitution of a bone was not at all understood, anatomists noted with particular care, every trifling peculiarity, in the forms or connections of its parts, and these lamellæ attracted particular notice. That a bone is formed in successive plates, is easily seen, as in whalebone ; or in the horns and bones of the larger animals ; in church-yard bones, which have been long buried, or long exposed to the air. It is demonstrated by a careful picking, and separation of the scales, in a young bone, or by burning a bone, which melts and consumes its gelly, and leaves the bony parts entire. It is seen in the common diseases of bones ; for they cast off by successive plates, or leaves, whence the process is named exfoliation ; and one plate is thoroughly spoiled and cast off, whilst another is entire, and sound. Malpighi had first observed the lamellated structure of bones, likening them to the leaves of a book. Gagliardi, who, like Hippocrates, went among the burial pla-

* That it is merely an expansion of the layers that forms the cancelli, and a mere swelling and sponginess of the same quantity of bony substance, that makes the ends so much thicker than the middle, is proved by this, that an inch of the smaller bony tube, cut from the middle, weighs equally with an inch of the large spongy tube, cut out from the ends.

ces of the city, to observe the bones there, found in a tomb, where the bones had been long exposed, a skull, the os frontis of which he could dissect into many layers, with the point of a pin. He afterwards found various bones, from all parts of the body, thus decomposed ; and he added to the doctrine of plates, that they were held together by minute processes, which going from plate to plate, performed the offices of nails : these appeared to his imagination to be of four kinds, straight and inclined nails, crooked or hook-like, and some with small round heads, of the forms of bolts or pins.*

Another notable discovery, was the use of the holes which are very easily seen through the substance of bones, and among their plates. They are, indeed, no more than the channels by which the vessels pass into the bones ; but the older anatomists imagine them to be still more important, allowing the marrow to transude through all the substance of the bone, and keep it soft. Now this notion, of lubricating the earthy parts of a bone, like the common talk about fomentations to the internal parts of the body, is very mechanical, and very ignorant ; for the internal parts of the body, are both hot and moist of themselves, and neither heat nor moisture can reach them from without : the bone is already fully watered with arteries ; it is moist in itself, and cannot be further moistened nor lubricated, unless by a fuller and quicker circulation of its blood. It must be preserved by that moisture alone which exists in its substance, and must depend for its consistence upon its own constitution ; upon the due mixing up of its gluten and earth. Every part is preserved in its due consistence by the vessels which form its subsistence ; and I should no more suppose fat necessary for preserving the moistness of a bone, than for preventing brittleness in the eye. This marrow is, perhaps, more an accidental deposition, than we at first sight believe. We indeed find in it such a regularity of structure, as seems to indicate some very particular use; but we find exactly the same structure in the common fat of the body. When, as we advance in years, more fat is deposited in the omentum, or round the heart, we cannot entertain the absurd notion of fat being needed in our old age, to lubricate the bowels or the heart; no more is the marrow (which is not found in the child,) accumulating in old age for preventing brittleness of the bones.

* These nails, which Gagliardi imagined, were no more than the little irregularities, rifings, and hollows of the adjoining plates, by which they are connected.

The blood vessels of a bone are large, in proportion to the mass of the bone: for first one great trunk enters commonly about the middle of the bone, as in the thigh-bone, leg or arm, and is called the nutritious or medullary artery; it penetrates into the central cavity of the bone, spreads upwards and downwards, supplying all the substance of the bone itself, and giving those delicate arteries which secrete the marrow. Other arteries enter from without, at the spongy ends of the bones, where the holes are not visible only, but very large in the adult; particularly large arteries enter into the heads of the bones, as of the shoulder, or of the thigh-bones; and there the periosteum adheres very strongly: and every where on its surface the bone is supplied by numerous vessels from the periosteum (and this seems, indeed, to be the chief use of that membrane;) so that in tearing off the periosteum, the surfaces of the membrane, and of the bone, are seen covered with bloody points; all the vessels are conducted to the substance of the bone by its two membranes: the internal vessels by the membrane which lines the cavity, and which is known by the absurd name of internal periosteum; the external one by the outer membrane, the proper or external periosteum.

The internal periosteum is that membrane which surrounds the marrow, and in the bags of which the marrow is formed and contained. It is more connected with the fat than with the bone; and in animals, can be drawn out entire from the cavity of the bone: but its chief use is to conduct the vessels which are to enter into the substance of the bone; and this connection and office is so essential to the life and health of the bone, that the spina ventosa, or scrophulous bone, is merely a failure of the internal circulation, a total corruption of the marrow, and a consequent loss of the medullary vessels; by which the whole bone dies, is thrown out by nature, or more frequently the limb must be cut off. The same effect is produced in our experiments, where, by piercing into the medullary cavity, and destroying the marrow, the shaft of the bone dies, while the heads and processes live, merely because they are supplied more fully by their external vessels.

The periosteum, which was once referred to the dura mater, is merely condensed cellular substance; of which kind of matter we now trace many varied forms and uses; for, so close is the connection of the periosteum, tendons, ligaments, fasciæ, and bursæ, and so much are these parts alike in their nature and properties, that we reckon them but as varied forms of one common substance, serving for various uses in different parts. The periosteum consists of many layers, accumulated and condensed one above another: it adheres to the body of

the bone by small points or processes, which dive into the substance of the outer layer, giving a firm adhesion to it, so that it may bear the pulling of the great tendons, which are fixed rather into the periosteum, than into the bone.* It is also connected with the bone, by innumerable vessels. It is not in itself vascular; but it is the medium by which vessels are transmitted to the bone; and our injections do not easily colour the periosteum itself, while they make the bone which belongs to it thoroughly red. The layers of the periosteum nearest to the bone, are condensed and strong, and take a strong adhesion to the bone, that the vessels may be transmitted safely, and the fibres of this inner layer follow the longitudinal directions of the bony fibres. The periosteum is looser in its texture outwardly, where it is reticulated and lax, changing imperceptibly into the common cellular substance. There the fibres of the periosteum assume the directions of the muscles, tendons, or other parts which run over it. The office of the periosteum is not to generate bone; and therefore it adheres but slightly to the growing bone: it is to nourish the external plates; and therefore as the bone grows, and as the external plates are further removed from the medullary vessels, the adhesion of the periosteum becomes closer, its arteries are enlarged, and the dependence of the outer layers on the periosteum is as well proved as the dependence of the body of the bone upon its medullary artery; for as piercing the medulla kills the whole bone, hurting the periosteum kills the outer layers of the bone. Any accident which robs the bone of its periosteum has this effect; accidental wounds of the periosteum, deep ulcers of the soft parts, as on the shin, the beating of aneurisms, the growth of tumours, the pressure even of any external body, will, by hurting the periosteum, cause exfoliation, which is, in plain terms the death of the external layer, by the injury of the outward vessels; and an active inflammation of the deeper layers, which being fully nourished by the internal arteries, inflame, swell, become porous and spongy, form granulations, and these granulations push off the mortified plate, and form themselves into new bone, which supplies its place.

The cartilages are also part of the living system of the bone: and we see too well, in the question of the bones themselves, how unphilosophical it must be, to deny organization and feeling to any part of the living body, however dead or

* It would appear that the arteries are convertible through time into these tooth-like processes, by which the periosteum is fixed into the bone; for in youth, the vessels are numerous, the adhesion slight, and the separation bloody; but in the older subject, the separation is more difficult, and less blood is seen.

insulated it may appear ; for every part has its degree of life : the eye, the skin, the flesh, the tendons, and the bones, have successive degrees of feeling and circulation. We see, that where even the lowest of these, the bone, is deprived of its small portion of life, it becomes a foreign body, and is thrown off from the healthy parts, as a gangrened limb is separated from the sound body ; and we speak as familiarly of the death of a bone, as of the gangrene of soft parts. How, then, should we deny organization and life to the cartilages, though surely, in respect of feeling, they must stand in the very last degree ?

The periosteum goes from the bone over the surface of the cartilage also, where it is named perichondrium : it still preserves its own vascular nature ; the vessels can be injected ; and it is not to be believed that the perichondrium has these vessels, without communicating them to the cartilage to which it belongs. We see red arteries in the centre of an ossifying cartilage ; and therefore we know that the trunk of the artery may be red, as in the ossifying part of the cartilage, and yet the extremity of the same artery be pellucid, as in the unossified part. Since vessels run through the cartilage to generate bone, we cannot, in reason, suppose that these vessels are produced in the instant in which they appear : they had existed before ; they are but dilated now : the increasing action dilates them, and the dilatation makes them red : this enables them to secrete bone, and, in many cases, as in the accidental joint formed by a fracture ill cared for, we can, by paring the cartilage, set the vessels free again, and make them begin to secrete.

Wherever we find a vascular membrane surrounding and nourishing any part, as the vitreous or crystalline humours in the eye, we must not suppose that such are insulated parts, maintained there by mere adhesion ; but must consider them as parts regularly organized, their vascular membrane being part of their living system ; and though the transparent humours of the eye, the cartilages and ligaments over all the body, and all the system of the bones, have been considered as mere concretes, and insulated parts, they are now known to be regular parts of the living whole. The cartilages have no very active circulation ; it is such as to keep them in life, but not so active as to endanger inflammation ; in the continual shocks which they must endure, their feeling must be very obscure ; for feeling also would have been inconsistent with their offices, which is to cover and defend the bones ; to yield to the weight of the body, and to restore themselves when that weight is removed ; to bear all the shocks of leaps or falls ; to

perform all the motions of the body, and the continual workings of the joints where they rub, and even grate upon each other, without danger or pain.

We now understand the constitution of a bone, and can compare it fairly with the soft parts in vascularity, and in feeling; in quickness of absorption; in the regular supply of blood necessary to the life of the bony system; in the certain death of a bone, when deprived of blood by any injury of its marrow, or of its periosteum, as a limb dies of gangrene, when its arteries are cut or tied; in the continual action of its absorbents, forming its cavity, shaping its processes and heads, keeping it sound and in good health, and regulating the degree of bony matter, that the composition may neither be too brittle nor too soft. From this constitution of a bone, we can easily foresee how the callus for uniting broken bones must be formed; not by a mere coagulation of extravasated juice, but by a new organization resembling the original bone.

The primordium of all the parts of the body is a thin gelatinous mucus, in which the forms of the parts are laid; and the preparation for healing wounds, and for every new part that needs to be formed, is a secretion of mucus which is soon animated by vessels coming into it from every point. In every external wound, in every internal inflammation, wherever external parts are to be healed, or internal viscera are about to adhere, a mucous matter is secreted, which serves as a bed or nidus, in which the vessels spread from point to point, till the mucus is animalized and converted into a membrane: and thus the heart, the intestines, the testicle, and other parts, adhere by inflammation to the coats which surround them, and which are naturally loose. It is a mucus of the same form which unites the ends of a broken bone; and, by breaking the bones of animals, and attending to the progress of the callus, we find first a thin mucus; then that thickened into a transparent gelly; that gelly growing vascular, and these vessels gradually depositing nuclei of ossification in the centre of the mass: and by madder, or by fine injections, we can make the gelly appear vascular, and the nuclei of ossification quite red. The colours of our injections begin to tinge the cartilage as it begins to ossify, and as soon as the ossification is general, it receives a general tinge.

Now when we find the substance of the oldest bone thus full of vessels, why should we doubt of its being able, from its own peculiar vessels, to heal a breach, or to repair any loss? We have no reason to refer the generation of callus to the marrow, to the periosteum, nor to the substance of the bone itself; for they are but parts of the common system of a

bone ; and each part of this system is of itself capable of regenerating the whole. How little the constitution of a bone has been understood, we may know from the strange debates which have subsisted so long about the proper organ for generating callus. Some have pronounced it to be the periosteum; others the medullary vessel, and internal membrane ; others the substance of the bone itself : but I have been employed in explaining, that not only any part of the bone, periosteum, or marrow, but even any artery in all the system, may assume that action which generates bone. In the heat of this dispute, one of the most eminent anatomists produced a diseased bone, where a new hone had been formed surrounding a carious one, and the spoiled bone rattled within the cavity of the sound one. Here we should have been ready to pronounce, that bone could be formed by the periosteum alone. But presently another anatomist produced the very reverse, viz. a sound young bone, forming in the hollow cylinder of a bone which had been long dead ; where, of course, the callous matter must have been poured into the empty cavity of the spoiled bone, from the ends which still remained sound, or must have been secreted by the medullary vessels. But the truth is, that callus may be thus produced from any part part of the system of a bone ; from its periosteum, from its medulla, or from the substance of the bone itself. If we pierce the bone of any animal, and destroy the marrow, the old bone dies, and a new one is formed from the periosteum : if we kill the creature soon, we find the new bone to be a mere secretion from the inner surface to the periosteum ; and if we wait the completion of the process, we find the new bone beautiful, white, easily injected, and thick, loose in its texture, and vascular and bloody, but still firm enough for the animal to walk upon ; and in the heart of it, we find the old bone dead and black. If we reverse this operation, and destroy the periosteum only, leaving the nutritious vessels entire, then the new bone is formed fresh and vascular by the medullary vessels, and the old one surrounds it quite black and dead ; and in fractures of the patella, or knee-pan, where there are no medullary vessels, the pieces are united by a callus, which is secreted from the vessels of the bone itself.

The diseases of the bones are the most frequent in surgery ; and it is impossible to express how much the surgeon is concerned in obtaining true ideas of the structure, constitution, and diseases of bones ; how tedious, how painful, and how loathsome these diseases are ; how often the patient must lose his limb, or endanger his life ; how very useful art is ; but, above all, what wonders nature daily performs in recovering bones from their diseased state.

CHAP. II.

OF THE SKULL IN GENERAL—THE BONES OF WHICH IT IS COMPOSED—THEIR TABLES—DIPLOE—SUTURES—THEIR ORIGINAL CONDITION, AND THEIR PERFECT FORM, REPRESENTED AND EXPLAINED.

WHILE the bones in general serve as a basis for the soft parts, and for supporting and directing the motions of the body, certain bones have a higher use in containing those organs whose offices are the most essential to life. The skull defends the brain; the ribs and sternum defend the heart and lungs; the spine contains that prolongation of the brain which gives out nerves to all the body: and the injuries of each of these are important in proportion to the value of those parts which they contain.

How much the student is interested in obtaining a correct and perfect knowledge of the skull, he must learn by slow degrees. For the anatomy of the skull is not important in itself only; it provides for a more accurate knowledge of the brain; explains, in some degree, the organs of sense; instructs us in all those accidents of the head which are so often fatal, and so often require the boldest of all our operations. The marks which we take of the skull, record the entrance of arteries; the exit of veins and nerves; the places and uses of those muscles which move the jaws, the throat, the spine. Indeed, in all the human body, there is not found so complicated and difficult a study, as this anatomy of the head; and if this fatiguing study can be at all relieved, it must be by first establishing a very regular and orderly demonstration of the skull.

For this end, we distinguish the face, where the irregular surface is composed of many small bones, from the cranium or skull cap, where a few broad and flat shaped bones form the covering of the brain. It is these chiefly which inclose and defend the brain, which are exposed to injuries, and are the subject of operation. It is these also that transmit the nerves. So that the cranium is equally the object of attention with the anatomist and with the surgeon.

All the bones of the cranium are of a flattened form, consisting of two tables, and an intermediate diploë, which answers to the cancelli of other bones. The tables of the skull are two flat and even plates of bone: the external is thought to be thicker, more spongy, less easily broken; the thinner

table, again, is dense, thin and brittle, very easily broken, and is sometimes fractured, while the external table remains entire: thence it is named tabula vitrea, or the glassy table. These tables are parted from each other by the distance of a few lines ;* and this space is filled up with the diploë, or cancelli. The cancelli, or lattice work, is a net of membranes, covered with vessels, partly for secreting marrow, and partly for nourishing the bone; and by the dura mater adhering to the internal surface, and sending in arteries, which enter into the cancelli by passing through the substance of the bone, and by the pericranium covering the external plate, and giving vessels from without, which also enter into the bone, the whole is connected into one system of vessels. The pericranium, dura mater, and skull, depend so entirely, one upon the other, and are so fairly parts of the same system of vessels, that an injury of the pericranium spoils the bone; separates the dura mater, and causes effusion upon the brain; a separation of the dura mater is, in like manner, followed by separation of the pericranium, which had been sound and unhurt; and every disease of the cancelli, or substance of the bone, is communicated both ways; inward to the brain, so as to occasion very imminent danger; outward towards the integuments, so as to warn us that there is disease. The general thickness of the skull, and the natural order of two tables, and an intermediate diploë, is very regular, in all the upper parts of the head. In perforating with the trepan, we first cut with more labour, through the external table; when we arrive at the cancelli, there is less resistance, the instrument moves with ease; there is a change of sound, and blood comes from the tearing of these vessels, which run in the cancelli, betwixt the tables of the skull. Surgeons thought themselves so well assured of these marks, that it became a rule, to cut freely, and quickly, through the outer table; to expect the change of sound, and the flow of blood, as marks of having reached the cancelli; and then to cut more deliberately, and slowly, through the inner table of the skull. But this shows an indiscreet hurry, and unpardonable rashness in operation. The patient, during this sawing of the skull, is suffering neither danger nor pain; and many additional reasons lead us to refuse, altogether, this rule of practice. For the skull of a child consists properly of one table only: or tables are not

* In anatomy there is occasion in almost every description, for a scale of smaller parts. The French divide their inch into twelve parts, each of which is a line. The French line, or twelfth of an inch, is a measure which I shall often have occasion to use.

yet distinguished, nor the cancelli formed: in youth, the skull has its proper arrangement of cancelli and tables; but still, with such irregularities, and exceptions, as make a hurried operation unsafe: in old age, the skull declines towards its original condition; the cancelli are obliterated; the tables approach each other, or are closed and condensed into one; the skull becomes irregularly thick, at some points, and at others thin, or almost transparent:—so that there can hardly be named any period of life, in which this operation may be performed quickly and safely at once. But, besides this gradual progress of a bone, increasing in thickness and regularity as life advances, and growing irregular and thinner in the decline of life, we find dangerous irregularities, even in younger skulls. There are often at uncertain distances, upon the internal surface of the skull, hollows and defects of the internal table, deep pits, or foveæ, as they are called, produced perhaps by the impression of contorted veins. These foveæ increase in size and in number as we decline in life; they are more frequent on the inner surfaces of the parietal and frontal bones; so that in those places where the skull should be most regular, we are never sure, and must, even in the safest places, perforate gradually and slowly.

BONES.—The bones of which the cranium, or skull-cap, is formed, are eight in number. 1. The FRONTAL BONE, or bone of the forehead, forms the upper and fore part of the head,—extends a little towards the temples, and forms also the upper part of the socket for the eye. 2. The PARIETAL BONES, are the two large and flat bones which form all the sides, and upper part of the head; and are named parietalia, as they are the walls or sides of the cranium. 3. The OS OCCIPITIS, is named from its forming all the occiput or back of the head; though much of this bone lies in the neck, and is hidden in the basis of the skull. 4. The OSSA TEMPORUM form the lower parts of the sides of the cranium: they are called temporal, from the hair that covers them being the first to turn grey, marking the time of life. 5. The OS ÆTHMOIDES, and, 6. the OS SPHENOIDES, are quite hidden in the basis of the skull: they are very irregular and very difficultly described, or explained. The OS ÆTHMOIDES, is a small square bone, hollow, and with many cells in it; it hangs over the nose, and constitutes a great and important part of that organ, and at the same time supports the brain. The olfactory nerves, by passing through it at many points, perforate it like a sieve; and it takes its name from this perforated or æthmoid plate. The OS SPHENOIDES, is larger and more irregular still; placed further back locked in betwixt the occipi-

tal and æthmoidal bones; lies over the top of the throat, so that its processes form the back of the nostrils and roof of the mouth; and it is so placed, as to support the very centre of the brain, and transmit almost all it nerves.

SUTURES.—All these bones are joined together by seams, which, from their indented, or dove-tailed appearance, are named sutures.

1. The CORONAL SUTURE, is that which joins the frontal to the parietal bones; extends almost directly across the head, from ear to ear; descends behind the eye, into the deep part of the temple; and there losing its serrated appearance, becomes like the squamous or scaly suture, which joins the temporal bones. It is named coronal, because the ancients wore their garlands on this part of the head. But the suture had been better intitled to this name, had it surrounded the head, than as it crosses it.

2. The LAMBDOIDAL SUTURE, is that which joins the parietals to the occipital bone. It begins behind the one ear, ascends, and arches over the occiput, and descends behind the other ear. It thus strides over the occiput, in a form somewhat resembling the letter lambda (Λ) of the Greeks; whence its name.

3. The SAGITTAL SUTURE, joins the parietal bones to each other; runs on the very top of the head; extends forwards from the lambdoidal suture, till it touches, or sometimes passes, the coronal suture; and from lying betwixt these two sutures, like an arrow betwixt the string and the bow, it has been named sagittal.

4. The TEMPORAL SUTURES, join the temporal bones to the parietal, occipital, and frontal bones; the sphenoid bone also enters into the temporal suture, just behind the eye. The temporal suture makes an arch corresponding almost with the arch of the external ear; it meets the coronal suture, an inch before the ear, and the lambdoidal an inch behind it. This back part belongs as much to the occipital as to the temporal bone; and so has been named sometimes additamentum suturæ lambdoidalis; sometimes additamentum suturæ squamosæ: for this temporal suture is, on account of the edge of the temporal and occipital bones being thin, and like scales of armour laid over each other, often named the squamous, or scaly suture.

5. The SPHENOIDAL and ÆTHMOIDAL SUTURES, are those which surround the many irregular processes of these two bones, and join them to each other, and to the rest.

6. The TRANSVERSE SUTURE, is one which, running across the face, and sinking down into the orbits, joins the bones of

the skull to the bones of the face; but with so many irregularities and interruptions, that the student will hardly recognize this as a suture.

7. The ZYGOMATIC SUTURE, is one which joins a branch of the temporal bone to a process of the cheek-bone; forming an arch, zygoma, or yoke; but this suture has little extent; it is a serrated appearance at one single point only.

To mark and know these sutures, and to be able to trace them in imagination, upon the naked head, to foresee where a suture will present, and how far it runs, may be a matter of great importance to the surgeon. Hippocrates, who has had more to praise his honesty than to follow his example, acknowledges his having mistaken a suture for a fracture of the skull; and since this warning, various contrivances and marks have been thought of, for preventing the like mistake. It may be useful to remember that the suture has its serræ or indentations; is firmly covered by the pericranium; is close, and does not bleed: but that a fissure, or fracture of the skull, runs in one direct line; is larger and broader at the place of the injury; grows smaller, as you recede from that, till it vanishes by its smallness; and that it always bleeds. Indeed the older surgeons, observing this, poured ink upon the suspected part, which, if the skull was hurt, sunk into the fissure, and made it black and visible; but left the suture untouched. They also directed to make the patient take a wire betwixt his teeth, which being struck, like the string of an instrument, he would feel the twang produce a painful and peculiar sensation in the fractured part of the head. But after all these observations, in place of any true and certain marks, we find a number of accidents which may lead us into a mistake.

Sutures cannot be distinguished by their serræ or teeth, for the temporal sutures want this common character, and rather resemble capillary fractures of the skull;* nor even by their places, for we know that there are often insulated bones (ossa Wormiana) surrounded with peculiar joinings, which so derange the course of the common sutures, that the joinings may be mistaken for fractures of the skull, and the ossa Wormiana for broken parts. Sometimes the squamous suture is double, with a large arch of bone intercepted betwixt the true and the false suture; or the sagittal suture, descending beyond its usual extent, and quite to the nose, has been mistaken for a fracture, and trepanned; and often in older skulls, the sutures are entirely obliterated, all over the head.

* Viz. Fractures as small as a hair, thence named capillary

If the surgeon should pour ink upon the skull, he would have reason to be ashamed of an experiment so awkward and unsuccessful; and for the old contrivance of a wire or cord held in the mouth, it cannot be done, since the patient is commonly insensible; and even, though less hurt, his feelings, after such an accident, must be very confused; he must be too liable to be deceived; and we cannot, on such slender evidence as this, perform so cruel an operation as cutting up the scalp, or so dangerous a one as the trepan.

For various reasons we are careful to trace the bones from their original soft and gristly state, to their perfect condition of hard bone; and most of all, we are concerned to do so in the head, where, in childhood, the appearances are not singular and curious only, but have always been supposed to indicate some wise and useful purpose. It is in this original condition of the soft and growing bones, that anatomists have sought to find a theory of the sutures, how they are formed, and for what uses. It has been remarked, that the number of pieces in the skull, is infinitely greater in the child than in the man. These bones ossifying from their centre towards their circumference, it happens, of course, that the fibres are close at the centre of ossification, and are more scattered at the extremities of the bone: when these scattered fibres of opposite bones meet, the growing fibres of one bone shoot into the interstices of that which is opposed: the fibres still push onwards, till they are stopped at last, and the perfect suture, or serrated line of union is formed.

In dilating this proposition, we should observe, that in the boy, all the bones in the head are membranous and imperfect. The membranous interstices begin to be obliterated; the sutures are beginning to close; the distinction of two tables is not yet established; the cancelli are not yet interposed betwixt the plates; the sinuses, or caverns of the bones, as in the forehead, the nose, and the jaw are not formed; and each bone is not only incomplete towards its edges and sutures, but consists often of many parts. The OS FRONTIS is formed of two pieces, which meet by a membranous union in the middle of the bone. The OSSA PARIETALIA have one great and prominent point of ossification in the very centre of each, from which diverging rays of ossification extend towards the edges of the bone. The OS OCCIPITIS is formed in four distinct pieces; and the TEMPORAL BONES are so fairly divided into two, that their parts retain in the adult the distinct names of petrous and squamous bones. Although these are all the regular points of ossification, yet sometimes there occur small and distinct points, which form irregular bones, uncertain in

number or size, found chiefly in the lambdoid suture, sometimes numerous and small, more commonly they are few in number, and sometimes of the full size of a crown, always distorting more or less the course of the suture, and being thus a subject of caution to the surgeon: these are named OSSA TRIQUETRA, or, TRIANGULARIA, from their angular shape, or, WORMIANA, from Olaus Wormius, who observed them first. Now the os frontis being formed in two larger pieces, their edges meet early in life, and they form a suture; but the bones continuing to grow, their opposite points force deeper and deeper into each other, till at last the suture is entirely obliterated, and the bones unite; and so this suture is found always in the child, seldom in the adult, almost never in old age. The occipital bone having four points, they are closer upon each other, they meet early, as soon united; and, although very distinct in the child, no middle suture has ever been found in the adult, but always the four pieces are united into one firm and perfect bone. The parietal bones have their rays most of all scattered; the rays of ossification run out to a great distance, and diverge from one single point, so that at their edges they are extremely loose, and they never fail to form sutures, by admitting into their interstices the points and edges of the adjoining bones. The surest and most constant sutures are those formed by the edges of the parietal bones; the sagittal in the middle, the coronal over the forehead, the lambdoidal behind, and the squamous suture, formed by their lower edges. But another phenomenon results at the same time, from this meeting and opposition of the fibres and interstices of the growing bones: that when the opposite fibres meet too early, they are not fairly admitted into the open spaces of the opposite bone: but the fibres of each bone being directly opposed point to point, they both turn inwards, and form a ridge or spine, such as is seen on the inner surfaces of the frontal and occipital bones. Such is the common theory, which I suspect is imperfect, and which should be received with some reserve, for all the phenomena are not yet explained; we find each suture always in its appointed place: we find nothing like a suture formed betwixt the head and body of a long bone, though they are formed in distinct points, and are not united till after the years of manhood; we find no sutures when bones are broken and reunited; when they have been spoiled, and are replaced; when a piece of spoiled bone has been cut away; or when a new shaft of a bone is formed by the secreting vessels, and is united to the heads of the old bone. These are accidents which hold us at least in doubt.

It has been supposed, and with much appearance of truth,

that the sutures limit the extent of fractures; leave a free communication of the internal with the external parts; that they must serve as drains from the brain; that they are even capable of opening at times, so as to give relief and ease in the most dreadful diseases of the head. But I fear we are not yet able to see the meaning of this peculiarity of structure; for the sutures are regular and uniform to a wonderful degree, while these uses of them are far from being proved.

The sutures surely were not intended by nature for limiting the extent of fractures: for fractures traverse the skull in all directions; cross the sutures with ease; and very often passing all the sutures, descend quite to the basis of the skull, where we dare not follow them with the knife, nor apply the trepan. Indeed we do not even know that limiting the extent of fractures could be a gracious provision of nature, since it would rather appear by the common accidents, that the more easily the bone yields, the less is the injury to the brain; and that where the fracture is wide and large, the symptoms are milder, and the danger less.

Neither were they intended as drains; for surely it is a bold position to assume, that nature has carefully provided for our making issues upon the sutures. When the original openness of the head and the membranous condition of the sutures was first observed, it was thought to be an observation of no small importance. The ancients believed that the membranes of the brain came out by the sutures, to form the pericranium, and going from that over the several joints, formed the periosteum for all the bones. They saw a close connexion betwixt the external and internal membranes of the skull; and they thought that nature had intended there a freer communication, and an occasional drain. They found the sutures particularly wide and membranous in a child, which they attributed to the watery state of its brain, requiring a freer outlet than in the adult; and accordingly they named the opening of the child's head the bregma, fons, fontanelle, the fountain, by which they believed there was a continual exudation of moisture from the brain.

We might have expected these notions to have vanished with the doctrines of humours and revulsion which gave rise to them; but both the doctrines and the practice, have been revived of late years; and a surgeon of some eminence has been at pains to examine various skulls, trying to find which of all the sutures remains longest open, and which should form the readiest and surest drain; and after a curious examination of each, he decidedly condemns the fontanelle; finds the additamentum of the squamous suture always open, and expects

this superior advantage from placing his issues there, that he will command at once a drain both from the cerebellum and from the brain. But these notions, so much cherished by the ancients, of derivation and revulsion, of serous humours falling upon the brain, of drains of pituita by the nose and through the sutures, have been long forgotten, and have not been effectually revived by this attempt.

It cannot be denied, that, in some instances, the sutures have continued quite open in persons grown in years, or have opened after a most wonderful manner, in some diseases of the head.

A young man having been brought into an hospital ill of a fever, the physicians observing with surprise a very strong pulsation behind the ear: upon applying the finger, a strong beating was felt; the part was soft and yielding; and upon opening his head, after death, there was found a large membranous space. Diemorbrock found the fontanelle open in a woman of forty years of age. Bauhin says, that in his own wife, twenty-six years of age, the sutures were not yet closed.

This fontanelle, or opening at the meeting of the coronal and sagittal sutures, was once thought to be a sure mark for the accoucher to judge by, both of the life of the child, and the direction in which its head presented. It is large and soft in a child; and the good women lay a piece of firm cloth upon it, and defend it with particular care. It begins to contract from the time of birth; and in the second and third year, it is entirely closed. Its closing is delayed by weakness, scrofulous complaints, and indeed by any lingering disease; it closes very late in rickets; and in hydrocephalic children the bones never close, but continue soft, yield to the watery swelling of the brain, and separate in a wonderful degree, so as to hold ten or twelve pounds.

As the sutures continue open in a hydrocephalic child, they are said to open again in the few instances where adults are seized with the same disease. We are told that it opens in those dreadful headaches which are sometimes fatal, and that the celebrated Paschal having died after terrible torments, was found to have the sutures opened again. It is even said that they open during disease, and close after the cure: "That a "man of forty years of age being in the dog-days seized with "a raging fever, delirium, watching, and dreadful pains of "the head, his sutures, opened on the seventh day, were as "wide as in a child; not only so as to be distinguished by the "finger, but that the attendants could see the pulsations of the "brain: the fever, after some time, abated; the pains ceased; the sutures closed, and this man lived many years in

"perfect health." So Hildanus reports the case; and he also says, in another instance, that the sutures had parted in a violent hemicrania, with an audible noise.

Yet, if this were a regular design of nature, the relief should be perfect; perhaps the opening of the sutures should be more easy, and the accident almost as common as diseases of the head: or perhaps it had been the more merciful order, to have determined a quick and sudden period for such dreadful and incurable diseases as these.

The sutures of the cranium are accidental merely, and of little use. The result, perhaps, of this well-known law, that nature seeks to facilitate ossification, by beginning the process in many points; and she establishes as many distinct points, in healing a broken limb as in forming the skull. But however they may be formed, their uses cannot be of that importance which has been supposed: for there are twenty separate bones, and twenty sutures in the face, where they can neither stop fractures, nor serve as drains, nor open so as to give relief.

But if the sutures of the cranium have any thing peculiar and different from those of the face, in that, perhaps, their peculiar uses may be found. We cannot pass unnoticed their looseness and flexibility in the new-born child; how wonderfully the head of the child is increased in length, and reduced in breadth in the time of delivery, and how much this conduces to an easy and happy labour.

The most eminent anatomists have condescended to remark, that in the various nations of Europe the head has various forms; which they ascribe to so slight a pressure as that which dress, or even the posture of the head, might produce. But how very far Vesalius was deceived in calculating thus, is easily proved. The Turks, says he, have their heads flattened by wearing the turban. But the turban is an eastern dress: the Turks or Tartars are a northern people, who assume this dress only when conquest brings them into a warmer climate; and the prominent cheek-bones, parted eyes, and flat heads, continue in the Tartars, who have but newly assumed the turban, while the conquered nations who have worn it long, are distinguished by their regular and beautiful features. Perhaps by contrivance and force, we may distort the head of a child; and we may almost believe what is told of the negroes of the Caribbee islands, who had contrived, by pressure, to flatten their children's heads, that their race might be in future distinguished from those who had submitted to the Spanish yoke; or of what is told so often of eastern nations, that they sometimes mould the heads of children into monstrous and uncouth forms, to extort charity, or as an act

of religion. Were I to assign a reason for the flexible bones, and wide sutures, and the yielding condition of the head of the child, I should say that it were meant by nature to stand in the place of that separation of the bones of the pelvis which has been supposed, but which cannot exist; for the child's head is moulded with little injury, is evolved again without help; and it seems a provision of nature, since the child scarcely feels the change: but no woman has been known to have the joinings of the pelvis relaxed or dissolved without pain and danger, confinement for many months, a temporary lameness; and sometimes she is rendered unable for life.

CHAP. III.

DESCRIPTION OF THE INDIVIDUAL BONES OF THE SKULL.

OS FRONTIS. This bone is compared with a clamshell. It is of a semicircular shape, hollowed like a shell, and very equal in its thickness. It is marked on the inside by a spine, or prominent line, which divides the hollow of the bone into two equal parts, and gives rise to a membranous partition, which divides and supports the hemispheres of the brain. It is marked on its external surface by those high ridges on which the eyebrows are placed; and by two prominences, under which are hollow caverns, named the SINUSES (or cavities) of the frontal bone. It is irregular only in its orbitary plates, which are the two thin and delicate lamellæ that depart from the general direction of the bone, and stand out horizontally so as to form a part of the socket for the eye, or, as it were, a roof defending the upper part of the eye, and a floor for supporting the lower part of the brain; and these two orbitary plates leave an open space, in which is incased the chief part of the æthmoid bone.

The first point to be remarked, is the SUPERCILIARY RIDGE, on which the eyebrows are placed: it is a prominent arched line, corresponding in size and length with the eyebrow which it supports. It is the origin of the frontal muscles. In this line, the integuments adhere very strongly, by many arteries which perforate the bone, and which are properly the nutritious arteries of this part of the bone; and we find all over the superciliary ridge many small holes through which these ar-

teries had passed. Among these, there is one hole which is larger, and which is distinguished from the rest; for its use is not like the others to transmit arteries to the bone, but to give passage to a small artery which comes out from the orbit, to mount over the forehead. Sometimes this artery turns freely over the border of the orbit, and makes no mark, or but a slight one: often laying closer upon the bone, it forms a notch; but most commonly, in place of turning fairly over the edge of the orbit, it passes obliquely through the superciliary ridge, and, by perforating the bone, makes a hole. This hole is named the SUPERCILIARY HOLE. The artery which comes from the eye to go out upon the forehead is named, where it passes the ridge, the superciliary artery; and higher up upon the forehead, the frontal artery. It establishes a communication betwixt the internal arteries of the eye, and the external arteries of the forehead and temple; and it carries along with it a small nerve from the eye, which going also out upon the forehead, is named the superciliary or frontal nerve. We are always warned of the danger of wounding arteries where they pass through bones; and strange stories are told of the terrible bleedings which have arisen from this artery when wounded near its hole; and of the convulsions, palsies, and loss of sight, which have arisen from the accidents, wounds, or lacerations of this frontal nerve: these stories are delivered on authorities which we dare not refuse, and yet they are such as we cannot easily believe.

This orbitary, or superciliary ridge, ends by two processes, which, forming the angles of the eye, are named the ANGULAR PROCESSES. The frontal bone has therefore four angular processes: 1. The two internal angular processes, forming the internal angles of the eyes; and, 2. The two external angular processes which form the external angles of each eye. Behind each external angular process, the bone lays flat, and sunk into a hollow which lodges the temporal muscles; and betwixt the two internal angular processes there is the NASAL POINT or PROCESS. This nasal process is a small sharp projecting point, which is exactly in the middle of the bone, occupying that space which is betwixt the two internal angular processes. It is very irregular and rough all round its root, for supporting the two small nasal bones; and this gives them a firm seat, and such a hold upon the root of the forehead, that they will be sooner broken than displaced.

At the inner end of the superciliary ridge, is that bump which marks the place of the frontal sinuses: it also in some degree indicates their size; for where this rising is not found, the sinuses are wanting, or are very small, but this is no sure,

nor absolute mark of the presence of these sinuses, which often, in the flattest foreheads, are not entirely wanting.

The sinuses* of the os frontis are two in number, one on either side above the root of the nose: they are formed by a receding of the two tables of the skull from each other: they are formed at first with the common cancelli, and at first they resemble the common cancelli, as if they were only larger cells: gradually they enlarge into two distinct cavities, often of very considerable size; going down into the orbitary plate, or sideways into the orbitary ridge, or upwards through one half of the frontal bone; and Ruisch had in a giantess (puella gigantica), seen them pass the coronal suture, and extend some way into the parietal bones.

The sinuses of either side are separated by a partition; but still they communicate by a small hole: sometimes the partition is almost wanting, and there are only crossings of the common lamellated substance; and though the communication with one another is not always found, they never fail to communicate with the nose. This indeed seems to be their chief use; for the frontal sinuses are the beginning of a great train of cells, which, commencing thus in the frontal bone, extend through the æthmoidal, sphenoidal, and maxillary bones, so as to form an organ of great extent and use belonging to the nose; but perhaps not so much for extending the organ of smelling, as for making a more sonorous voice. For we have no proof that the sinuses are part of the organ of smell; unless we should accept of this as a proof, that by the smelling of strong volatiles, pain shoots upwards into the forehead; though, by this rule, the eyes should be also a part of the same organ, since from the same cause, they are pained, and tears begin to flow: but we do know that the sinuses belong to the voice, and raise its tone, for we feel the trembling note resound through all the cells; so that the voice is sonorous while they are free; is damped when the sinuses are oppressed by their membranes being thickened by cold; or is almost suppressed when the sinuses are entirely closed; or when, by venereal ulcers, the curtain of the palate is consumed, no part of the voice passing upwards into the nose, it is almost lost.

This has given rise to a very common mistake: that as these sinuses are wanting in the child whose forehead is flat, as

* The word Sinus is used in two senses: we call the cavities or cells within the substance of a bone, the sinuses of that bone; as the sinuses of the forehead, of the sphenoid, æthmoid, or maxillary bones: we call also certain great veins by the same name of sinuses. Thus the great veins being enlarged where they approach the heart, and the veins being particularly large in the brain and the womb, we call them the sinuses of the heart, of the brain, and of the womb.

they enlarge gradually, and are fully formed about the fifteenth year, the vox rauca, the breaking of the voice, which is observed about that time, must be owing to the evolution of these cells. But the female voice does not undergo the same change by the evolution of these cells; and castration, which surely can have no effect on these cavities, keeps down the eunuch's to the treble key of the female voice. The mistake lies in supposing these cavities to raise the tone or note in which we speak, while they only add clearness and strength. The membrane which lines these cavities is thin, and exquisitely sensible, and is a continuation of the common membrane of the throat and nose. A thin humour is poured out upon its surface to moisten it and keep it right. This the ancients did not consider as merely a lubricating fluid, but as a purgation of the brain, drawn from the pituitary gland; which could not be diminished without danger, and which it was often of consequence to promote.

These sinuses are subject to one accident chiefly, viz. insects, which nestle there, and produce inconceivable distress; and it is particular, that insects more frequently lodge in the frontal sinuses, than in the cavities of any of the other bones. In sheep and dogs, such insects are very frequent, as, in seeking their food, they carry their nose upon the ground; and it has been proved, or almost proved, that in man they arise from a like cause. Indeed what can we suppose, but that they get there by chance? Thus, a man having slept in barns, was afflicted with dreadful disorders in the forehead, which were relieved upon discharging from the nose a worm of that kind which is peculiar to spoiling corn; while others have had the complaint, by sleeping upon the grass. But there is something very particular in this, that by far the greater number of these worms have been of the centipede kind; generally long, an inch in length, with one hundred, or according to Linnæus, one hundred and twelve feet, and not unfrequently covered with hair. There are reports which seem to prove, that some have died of this complaint, and in a very miserable way. In many cases it has been attended with delirium; and in almost every instance it has continued for years. No wonder, then, that the trepanning of these sinuses has been often proposed; but I have never read of a well marked case, so that we could be assured beforehand of finding worms; they have, in most cases, been discovered rather by chance. The patient might be relieved on easier terms, by the injection of aloes, assafœtida, myrrh, the use of snuff or smoaking, and pressing the fumes upwards into the nose. Much

should be tried, before undertaking a dangerous operation on such slender proofs.

It may be right, in cases of fractures, to decline applying the trepan above the sinuses, unless a fracture cannot be raised in any easier way; and we must be, especially, careful to distinguish a fracture of the outer table only, from entire fractures of this bone. For Palfin says, that the outer table being broken, and the natural mucus of the sinus being corrupted and flowing out, has been mistaken for the substance of the brain itself. And Parée, who first gives this caution, affirms, "that he had seen surgeons guilty of this mistake, "applying the trepan, and so killing their unhappy patients."

The SPINE or RIDGE which runs upon the internal surface of the frontal bone, is to be observed, as it gives a firm hold to the falx, or that perpendicular membrane, which, running in the middle of the head, divides and supports the brain. This is more or less prominent in different skulls, and according to the age. The spine is more prominent at its root; but as it advances up the forehead, it decreases, and often ends in a groove. The spine gives firm hold for the falx, and the groove lodges the great longitudinal sinus, or, in other words, the great vein of the brain, which runs along the head, in the course of the perpendicular partition or falx. At the root of this spine, there is a small blind hole, which will just admit a pin; it is named blind, because it does not pass quite through the bone, and the beginning of the falx, dipping down into this hole, gets a firmer hold. The ancients thinking that this hole descended through both tables into the nose, believed, that the dangerous and ungovernable bleedings at the nose, must be through this hole, and from the fore end, or beginning of the longitudinal sinus.

The ORBITARY PROCESS is the last remarkable point of the frontal bone. The orbitary processes are two thin plates, departing from the general direction of the bone, and standing inwards at right angles: they cover the eye, and support the brain. By the continual rolling of the eye, and the pressure of the brain, they are extremely thin and transparent; the rolling of the eye makes them exquisitely smooth below, and on their upper surfaces they are impressed with the frequent convolutions of the brain: so that a wound through the eye endangers more than the eye; for it passes easily forward into the brain, and is instantly fatal: it is the aim of a fencer; and we have known, in this country, a young man killed by the push of a foil which had lost its guard.

Upon the orbitary plate, and just under the superciliary ridge, there are two depressions in the socket of each eye:

the one is very small, and deeper at the inner corner of the eye, under the orbitary hole, which is the mark of the small cartilaginous pulley, in which the tendon of one of the muscles of the eye plays; the other, a more gentle and diffused hollow, lies under the external angular process, is not deep, but is wide enough to receive the point of a finger, and is the place where the lachrymal gland lies; that gland which secretes the tears, and keeps the eye moist.

OSSA PARIETALIA.—The parietal bones form by much the greater share of the cranium: they are more exposed than any others; they are the most frequently broken, and the most easily trepanned; for the parietal bones are more uniform in their thickness, and more regular in their two tables and diploë, than any others. But the accidental varieties of pits and depressions are very frequent in them; and the sinus or great vein, and the artery which belongs to the membranes of the brain, both make their chief impressions upon this bone.

Each parietal bone is very nearly of a square form, surrounded by deeply serrated edges, which unite them with each other, and with the occipital and frontal bones. All the corners of this bone are obtuse, except that one which lies in the temple, and which, running out to a greater length than the other corners, is sometimes named the SPINOUS PROCESS of the parietal bone; though there can be no true process in a bone so regular and flat. The lower edge of the bone is a neat concave semicircle, which joins the parietal to the temporal bone; and the edge of each is so slanted off, that the edge of the temporal overlaps the edge of the parietal, with a thin scale, forming the squamous suture. About an inch above the squamous suture, there is a semicircular ridge, where the bone is particularly white and hard; and rays extend downwards from this, converging towards the jugum, or arch of the temple. The white semicircular line represents the origin of the temporal muscle; and the converging lines express the manner in which the fibres of the muscle are gathered into a smaller compass, to pass under the jugum. The sagittal suture, or meeting of the two parietals, is marked on the inside with a groove as big as the finger, which holds the longitudinal sinus, or great vein of the brain: but the groove is not so distinctly seen, unless the two bones be put together; for one half of this flat groove belongs to each bone.

The great artery of dura mater touches this bone at that angle of it which lies in the temple. It traverses the bone from corner to corner, spreading from the first point, like the

branches of a tree, it beats deep into the bone where it first touches it; but where it expands into branches, its impressions are very slight; commonly it makes a groove only, but sometimes it is entirely buried in the bone; so that at the lower corner of the parietal bone we cannot escape cutting this vessel, if we are forced to operate with the trepan.

There is but one hole in the parietal bone: it is small and round, is within one inch of the meeting of the lambdoidal and sagittal sutures, and gives passage to a small external vein, which goes inwards to the sinus; and to a small artery which goes also inwards to the dura mater, or rather to the falx.

The meeting of the frontal and parietal bones, being imperfect in the child, leaves that membranous interstice, which by some is named folium or folliolum, from its resembling a trefoil leaf; and was named by the ancients hypothetically, bregma, fons,* or fountain; they thinking it a drain of moisture from the brain: and so the parietal bones are named ossa bregmatis.

OS OCCIPITIS.—This bone has also the names of os memoriæ, and os nervosum. It is the thickest of the cranial bones, but is the least regular in its thickness, being transparent in some places, and in others swelling into ridges of very firm bone. It gives origin or insertion to many of the greatest muscles, which move the head and neck; it supports the back part of the brain; contains the cerebellum or lesser brain; transmits the spinal marrow, and is marked with the conflux of the chief sinuses, or great veins of the brain.

The EXTERNAL SURFACE is exceedingly irregular, by the impressions of the great muscles of the neck: for first the trapezius and complexus, two great external muscles of the neck and head, have their chief hold upon the occipital bone, by which there is formed one great TRANSVERSE SPINE. Below these again, the recti muscles, two small and deep muscles of the head and neck, make another transverse spine below the first: so that there is a double transverse spine; and the interstice betwixt the muscles of the opposite sides leaves, of course, a prominent ridge or spine, which, running from above downwards, crosses the first ridges, and makes a cross called the CRUCIAL SPINE; and in a strong man advanced in years, where the ridges and hollows are strongly marked, the

* The word pulsatilis, or fons pulsatilis, or beating fountain, was added, because we feel the beating of the arteries of the brain there.

point where these ridges cross, is so very prominent, as to be named the POSTERIOR TUBEROSITY of the occipital bone.

The INTERNAL SURFACE. Opposite to these ridges, there are similar crucial ridges within; but more regular, smooth, and equal, and making only one transverse line. The TENTORIUM CEREBELLO SUPER-EXTENSUM, is a diaphragm or transverse partition, which crosses the skull at its back part; cuts off from the rest of the cranium the hollow of the occipital bone; appropriates that cavity for the cerebellum, and defends the cerebellum from the weight and pressure of the brain. This tentorium, or transverse membrane, is attached to the GREAT INTERNAL RIDGE of the occipital bone. In the angle where this membrane is fixed to the ridge, lies the great sinus or vein, which is called longitudinal sinus, while it is running along the head; but the same sinus, dividing in the back of the head, into two great branches, changes its name with its direction; and the forkings of the vessel are named the right and left lateral sinuses, which go down through the basis of the skull; and being continued down the neck, are there named the great or internal jugular veins. This forking of the longitudinal, into the lateral sinuses, makes a TRIANGULAR or TRIPOD-LIKE GROOVE, which follows the internal ridges of the occipital bone: and above and below the transverse ridge, there are formed four plain and smooth hollows. The two upper ones are above the tentorium, and contain the backmost lobes of the brain; the two lower ones are under the tentorium, and hold the lobes of the cerebellum or little brain.

PROCESSES. The processes or projections of the occipital bone are few and simple. 1. There is a part of the bone which runs forward from the place of the foramen magnum; lies in the very centre of the base of the skull; and joins the occipital to the sphenoidal bone: and which, both on account of its place (wedged in the basis of the skull,) and of its shape, which is rather small, and somewhat of the form of a wedge, is named the CUNEIFORM, or WEDGE-LIKE PROCESS of the occipital bone. And, 2. There are two small oval processes, or button-like projections, which stand off from the side, or rather from the forepart of the foramen magnum, or great hole, and which, being lodged in joints belonging to the upper bone of the neck, form the hinge on which the head moves. These two processes are named the CONDYLES of the occipital bone. They are not very prominent, but rather flattened; are of an oval form, and have their fore-ends turned a little towards each other; so that by this joint the head moves directly backwards or forwards, but cannot turn or roll. The

turning motions are performed chiefly by the first bones of the neck. Round the root of each condyle, there is a roughness, which shows where the ligament ties this small point to the corresponding bone of the neck.

HOLES.—1. These condyles stand just on the edge of the FORAMEN MAGNUM, or great hole of the head, which transmits the spinal marrow, or continuation of the brain; and the edges of this hole (which is almost a regular circle) are turned and smoothed; a little thicker at the lip, and having a roughness behind that, giving a firm hold to a ligament, which, departing from this hole, goes down through the whole cavity of the spine, forming at once a sheath for the spinal marrow, and a ligament for each individual bone. There passes down through this great hole the spinal marrow, and the vertebral vein. There come up through it the vertebral arteries, which are of great importance and size; and a small nerve, which, from its coming backwards from the spine to assist certain nerves of the brain, is named the spinal accessary nerve.

2. The second hole is placed a little behind the ring of the foramen magnum, and just at the root of either condyle, is round, and large, easily found, and sometimes it is double; it transmits the ninth pair, or great lingual nerve.

3. There is another hole smaller, and less regular than this last. It is exactly behind the condyle, while the lingual hole is before it. It is for permitting a small vein, the cervical vein of the neck, to enter and drop its blood into the great lateral sinus; but often it is not formed, and this trifling vein gets in by the great occipital hole.

4. We shall describe with the temporal bone that wide hole which is common to the temporal and occipital bones, and which transmits the great lateral sinus.

OS TEMPORIS.—The temporal bone is, in the child, two bones; which retain their original names of pars petrosa and pars squamosa. The whole bone is very irregular in its thickness, and hollows, and processes. The PARS SQUAMOSA is a thin or scaly part; rises like a shell over the lower part of the parietal bone, and is smoothed and flattened by the rubbing of the temporal muscle. The PARS PETROSA, often named OS LAPIDOSUM, or stony bone, is hard, irregular, rocky; juts inward towards the basis of the skull; contains the organ of hearing, and, of course, receives and transmits all the nerves which are connected with the ear. There is a third portion of this bone, viz. the occipital angle, which is thick and hard; is divided into cells, and forms those caverns which are supposed to be chiefly useful in reverberating the sound.

The squamous part is grooved, to make the squamous suture; is scolloped or fringed; and exceedingly thin on its edge; it is radiated, in consequence of its original ossification shooting out in rays. The petrous part again is triangular, unequal by the cavities of the ear; it has a very hard, shining, polished-like surface; exceeded in hardness by nothing but the enamel of the teeth. Where it projects into the base, it has several open points, which are filled up with cartilaginous or ligamentous substance; and its occipital angle is connected with the other bones by the additamentum suturæ squamosæ.

Processes. 1. The zygomatic process rises broad and flat before the ear; grows gradually smaller as it stretches forward to reach the cheek bone: forms with a process of that bone the zygoma, yoke, or arch of the temple, under which the temporal muscle plays. The temporal muscle is strengthened by a firm covering of tendon, which stretches from the upper edge of this zygoma to the white line on the parietal bone; and several muscles of the face arise from the lower edge of the zygoma, particularly one named masseter, which moves the jaw; and one named zygomaticus, or distortor oris, because it draws the angle of the mouth. The zygomatic process is united by a short suture to the cheek-bone.

2. The styloid process, is so named from a slight resemblance to the stylus, or point with which the ancients engraved their writings on tables of wax. It is cartilaginous long after birth; even in the adult, it is not completely formed; it is exceedingly delicate and small; and when its cartilaginous point is fairly ossified, as in old men, it is sometimes two inches long. It stands obliquely out from the basis of the head, and is behind the jaw; so that it gives convenient origin to a ligament which goes downwards to support the os hyoides, or bone of the tongue; and it is the origin of many curious muscles, chiefly of the throat and jaws. One slender muscle going downwards from the styloid process, and expanding over the pharynx, is called stylo-pharingeus; one going to the os hyoides, is the stylo-hyoideus; one going to the tongue, is the stylo-glossus; and since the process is above and behind these parts, the muscles must all pull backwards and upwards, raising according to their insertions, one the pharynx, another the os hyoides, another the tongue.

3. The vaginal process will not be easily found, nor acknowledged as a process; for it is only a small rising of a ridge of the bone, with a rough and broken-like edge, on the middle of which the styloid process stands: it is, in short, the root of the styloid process; and anatomists have chosen to observe it, though it gives origin to no particular part; and they

have named it vaginalis, as if it resembled a sheath for the styloid process.

4. The MASTOID or MAMMILLARY PROCESS, is a conical nipple-like bump, like the point of the thumb ; it projects from under the ear, and is easily felt with the finger without ; it is hollow, with many cells which enlarge the tympanum, or first cavity of the ear, and are thought to reverberate and strengthen the sound. Under its root, there is a deep and rough rut which gives a firm hold to the first belly of the digastric muscle ; and the point or nipple of this process is the point into which the mastoid muscle is inserted from before, and the complexus, obliquus, and trachelo-mastoidæus muscles from behind. It has been proposed of late years, that, in certain cases of deafness, we should open this part with the trepan.

5. The AUDITORY PROCESS is just the outer margin of the hole of the ear. It is in a child a distinct ring, which is laid upon the rest of the bone. The membrane of the ear is extended upon this ring, like the head of a tambour upon its hoop, whence this is named the circle of the tambour by the French, and by us the drum of the ear. In the adult this ring is fairly united to the bone, and is named the processus auditorius ; and may be defined a circle, or ring of bone, with a rough irregular edge ; the drum or membrane of the ear is extended upon it, and the cartilaginous tube of the ear is fixed to it ; and this ring occupies the space from the root of the mammillary to the root of the zygomatic process.

HOLES. The temporal bone is perforated with many holes, each of which relates to the organ of hearing ; some for permitting nerves to enter ; others for letting them out ; and others for the free passage of air to the internal ear.

1. The MEATUS AUDITORIUS EXTERNUS (the circle of which has been described,) is covered with the membrane of the drum, and communicates the vibratory motion of the air for moving and exciting the internal organs.

2. The MEATUS AUDITORIUS INTERNUS, is that hole by which the auditory nerves have access to the ear. It is a very large hole, seated upon the back of the pars petrosa, which is of a triangular form. The hole is at first large, smooth, almost a regular circle, with a sort of round lip. Within this there are seen many small holes, the meaning of which is this : the auditory nerve is double from its very origin in the brain : it consists, in fact, of two distinct nerves, the portio dura, and the portio mollis. The portio mollis is a large soft and delicate nerve, which constitutes the true organ of hearing ; and when it is admitted into the ear, it is expanded into a thin web which spreads over all the cavities of the ear, as the cochlæa, semi-

circular canals, &c. The portio dura, the smaller part of the nerve, passes indeed through the ear, but it is quite a foreign nerve; it is not distributed within the ear; it keeps the form of a distinct cord, and passing through the temporal bone, it comes out upon the cheek, where it is expanded: so that the portio dura is a nerve of the face, passing through the ear, but forming no part of that organ. Thus the two nerves, the portio dura and the portio mollis, enter together; they fill the greater hole, and then they part; the portio dura, entering by one distinct hole, takes its course along a distinct canal, the aqueduct of Fallopius, from which it comes out upon the cheek; while the portio mollis entering by many smaller holes into the cochlæa, semicircular canals, and other internal parts of the ear, is expanded in these cavities to form the proper organ of hearing.

3. There is upon the fore part of the petrous bone a small hole which will admit the point of a pin. This hole receives a small twig reflected from the fifth pair of nerves: the nerve is as small as a sewing thread; it can be traced along the petrous bone by a small groove which conducts it to the hole; and when it enters the ear, it goes into the same canal with the portio dura, and joins itself to it.

4. The hole by which the portio dura passes out upon the cheek, is found just before the mastoid, and behind the styloid process; and being betwixt the two, it is named the STYLO-MASTOID hole, and is so small, as just to admit a pin.

5. The hole for the Eustachian tube is very irregular. No air can pass through the membrane of the drum; and as air is necessary within the ear, it is conveyed upwards from the palate by the ITER A PALATO AD AUREM, or as it is commonly called, the EUSTACHIAN TUBE. This tube is long, and of a trumpet form; its mouth, by which it opens behind the nostril, is wide enough to receive the point of the finger; it grows gradually smaller as it advances towards the ear; it is cartilaginous in almost its whole length; very little of it consists of firm bone; so that the student, in examining the skull, will hardly find the Eustachian tube; for the cartilage being rotten away, nothing is left but that end of the canal that is next the ear, and which is open both above and below, ragged, irregular, and broken.

When we have a sore throat, the pain extends up along this tube into the ear; when we have a cold, both our voice and our hearing is hurt; the one by the stuffing of the sinuses, the other by the stuffing of the Eustachian tube. When we shut the nose and mouth, and blow strongly, we feel a crackling in the ear, as in the place of the Eustachian tube; when we dive,

we feel the same, by the condensation of the air: and sometimes by forcing the air strongly upwards through the ear, or by vomits, obstruction of the Eustachian tube, and the deafness which attends that accident, are very suddenly, and we may say, violently removed; or sometimes the cure is attempted by syringing, or by cleaning the mouth of this tube with a probe, just as we do the external ear.

The other holes do not relate to the ear, and are chiefly for transmitting the great blood-vessels of the brain.

1. The CAROTID ARTERY, the chief artery of the brain, enters into the skull near the point of the petrous bone, and just before the root of the styloid process. The artery goes first directly upwards, then obliquely forwards through the bone, and then again upwards, to emerge upon the inside of the skull; so that the carotid makes the form of an Italic *S*, when it is passing through the substance of the bone; and in place of a mere hole, we find a sort of short canal, wide, a little crooked, and very smooth within. There seems to be a particular design in this angle, which the artery is forced to make: perhaps it is designed to abate the violence with which the blood would drive forwards into the brain; for in many of the lower animals, there are still more particular provisions than this, the artery being prevented from entering the brain in one great trunk, by a curious division, into many branches, which meet again. It is at this particular point that we are sensible in our own body of the beating of these two great arteries; and Haller is at pains to inform us, that, during a fever, he felt this beating in a very distressing degree.

2. The GREAT LATERAL SINUS comes out through the temporal bone, to form the internal jugular vein. The course of the sinus may be easily traced by the groove of the occipital bone downwards, behind the pars petrosa: there also it makes a deep groove, and ends with a large intestine-like turn, which makes a large cavity in the temporal bone, big enough to receive the point of the finger. The sinus passes out, not by any particular hole in the temporal bone, but by what is called a COMMON HOLE, viz. formed one half by the temporal, and one half by the occipital bone. This hole is very large; is lacerated or ragged-like. It is sometimes divided into two openings, by a small point, or spine of bone. The larger opening on one side of that point transmits the great sinus, where it begins to form the jugular vein; and the smaller opening transmits the eighth nerve of the skull, or par vagum which goes down towards the stomach, along with the jugular vein.

There is a small furrow upon the very angle or ridge of the petrous bone, which is made by a small vein of the brain going towards the end of the lateral sinus.

3. There is a small hole on the outside of this bone, in the occipital angle; or rather the hole is oftener found in the line of the suture (the additamentum suturæ squamosæ.) Sometimes it is in the occipital bone; or sometimes it is wanting: it transmits a trifling vein from without, into the great sinus, or a small artery going to the dura mater.

That hollow under the root of the zygomatic process, which lodges the hinge of the jaw-bone, must be described along with the lower jaw.

The ÆTHMOID BONE.—This is perhaps one of the most curious bones of the human body. It appears almost a cube, not of solid bone, but exceedingly light, spongy, and consisting of many convoluted plates, which form a net-work like honey-comb. It is curiously inclosed in the os frontis, betwixt the orbitary processes of that bone. One horizontal plate receives the olfactory nerves, which perforate that plate with such a number of small holes, that it resembles a sieve; whence the bone is named cribriform, or æthmoid bone. Other plates dropping perpendicularly from this one, receive the divided nerves, and give them an opportunity of expanding into the organ of smelling; and these bones, upon which the olfactory nerves are spread out, are so much convoluted, as to extend the surface of this sense very greatly, and are named spongy bones. Another flat plate lies in the orbit of the eye; and being very smooth by the rolling of the eye, it is named the os planum, or smooth bone. So that the æthmoid bone supports the forepart of the brain, receives the olfactory nerves, forms the organ of smelling, and makes a chief part of the orbit of the eye; and the spongy bones, and the os planum, are neither of them distinct bones, but parts of this æthmoid bone.

The CRIBRIFORM PLATE is exceedingly delicate and thin; lies horizontally over the root of the nose; and fills up neatly the space betwixt the two orbitary plates of the frontal bone.

The olfactory nerves, like two small flat lobes, lie out upon this plate, and adhering to it, shoot down like many roots through this bone, so as to perforate it with numerous small holes, as if it had been dotted with the point of a pin, or like a nutmeg grater.

This plate is horizontal; but its processes are perpendicular, one above, and three below.

1. The first perpendicular process is what is called CRISTA GALLI; a small perpendicular projection, somewhat like a cock's comb, but exceedingly small, standing directly upwards from the middle of the cribriform plate, and dividing that

plate into two; so that one olfactory nerve lies upon each side of the crista galli; and the root of the falx or septum betwixt the two hemispheres of the brain, begins from this process. The foramen cæcum, or blind hole of the frontal bone, is formed partly by the root of the crista galli, which is very smooth, and sometimes, it is said, hollow or cellular.

2. Exactly opposite to this, and in the same direction with it, *i. e.* perpendicular to the æthmoid plate, stands out the NASAL PLATE of the æthmoid bone. It is sometimes called the azygous, or single process of the æthmoid, and forms the beginning of that septum or partition which divides the two nostrils. This process is thin, but firm, and composed of solid bone; it is commonly inclined a little to one side, so as to make the nostrils of unequal size. The azygous process is united with the vomer, which forms the chief part of the partition; so that the septum, or partition of the nose, consists of this azygous process of the æthmoid bone above, of the vomer below, and of the cartilage in the fore or projecting part of the nose; but the cartilage rots away, so that whatever is seen of this septum in the skull, must be either of the æthmoid bone or the vomer.

3. Upon either side of the septum, there hangs down a SPONGY BONE, one hanging in each nostril. They are each rolled up like a scroll of parchment: they are very spongy; are covered with a delicate and sensible membrane; and when the olfactory nerves depart from the cribriform plate of the æthmoid bone, they attach themselves to the septum, and to these upper spongy bones, and expand upon them so, that the convolutions of these bones are of material use in expanding the organ of smelling, and detaining the odorous effluvia till the impression be perfect. Their convolutions are more numerous in the lower animals, in proportion as they need a more acute sense. They are named spongy, or turbinated bones, from their convolutions, resembling the many folds of a turban.

The spongy bones have a great many honey-comb-like cells connected with them, which belong also to the organ of smell, and which are useful perhaps by detaining the effluvia of odorous bodies, and also by reverberating the voice. Thus, in a common cold, while the voice is hurt by an affection of these cells, the sense of smelling is almost lost.

4. The ORBITARY PLATE of the æthmoid bone is a large surface; consisting of a very firm plate of bone, of a regular square form; exceedingly smooth and polished: it forms a great part of the socket for the eye, lying on its inner side.

When we see it in the detached bone, we know it to be just the flat side of the æthmoid bone; but while it is incased in the socket of the eye, we should believe it to be a small square bone; and from this, and from its smoothness, it has got the distinct name of OS PLANUM.

5. The OS UNGUIS should also, perhaps, be counted as a part of this bone; for though the os unguis, when observed in the orbit, seems to be a small detached bone, thin like a scale, and of the size of the finger nail (whence it has its name,) yet in the adult, the os unguis is firmly attached to the æthmoid bone; comes along with it when we separate the pieces of the skull: and when the os unguis is pared off from the æthmoid bone, the cells are exposed.

This os unguis, then, is a small scaly-like plate, in the inner corner of the orbit just over the nose. We find in it that groove which holds the lachrymal sac, and conducts it to the nose; and it is this thin bone that we perforate in making the new passage into the nose, when there is an obstruction in the natural duct.

6. The CELLS of the æthmoid bone, which form so important a share of the organ of smell, are arranged in great numbers, along the spongy bone. They are small neat cells, much like a honey-comb, and regularly arranged in two rows, parted from each other by a thin partition; so that the os planum seems to have one set of cells attached to it, while another regular set of cells belongs in like manner to the spongy bones. The cells are thus twelve in number,* opening into each other, and into the nose.

These cells are frequently the seat of venereal ulcers, and the spongy bones are the surface where polypi often sprout up. And from the general connections and forms of the bone, we can easily understand how the venereal ulcer, when deep in the nose, having got to these cells, cannot be cured, but undermines all the face; how the venereal disease, having affected the nose, soon spreads to the eye, and how even the brain itself is not safe. We see the danger of a blow upon the nose, which, by a force upon the septum, or middle partition, may depress the delicate cribriform plate, so as to oppress the brain with all the effects of a fractured skull, and without any operation which can give relief. And we also see much danger in pulling away polypi, which are firmly attached to the upper spongy bone.

* The number is commonly twelve, but not regularly so.

SPHENOIDAL BONE.—The sphenoidal bone completes the cranium, and closes it below. It is named SPHENOID, CUNEIFORM, or WEDGE-LIKE bone, from its being incased in the very basis of the skull; or it is named os MULTIFORME, from its irregular shape. It is much the shape of a bat, whence it is often named the PTERYGOID BONE, its temporal processes being like extended wings; its pterygoid processes like feet; its middle like the body and head of a bat. Its wing-like processes are in the hollow of the temple, forming a part of the squamous suture, and also composing a part of the orbit of the eye: its pterygoid processes hang over the roof of the mouth, forming the back of the nostrils. The body is in the very centre of the skull, and transmits almost all the nerves of the brain; but still the body bears so small a proportion to the bone, that we have not a regular centre to which all the processes can be referred; so that we are always, in describing this bone, moving forwards from point to point, from one process or hole to the next.

PROCESSES.—1. The ALÆ, or WINGS, often named temporal processes, rise up in the temple, to form part of the hollow of the temple; and these wings of the sphenoid bone meeting the frontal, parietal, and temporal bones, by a thin scaly edge, they make part of the squamous suture, and give a smooth surface for the temporal muscle to play upon.

2. The other side of this same process looks towards the socket of the eye, and has a very regular and smooth surface; it is exactly opposite to the os planum. As the æthmoid bone forms part of the inside of the orbit, the wing of the sphenoid bone forms part of the outside of the orbit; and so the surface turned towards the eye is named the ORBITARY PROCESS of the sphenoid bone.

3. The lower, or back part of this bone runs out into a narrow point, which sinks in under the petrous portion of the temporal bone, and being sharp pointed, it is named the SPINOUS PROCESS. It is very remarkable for a small hole which permits the great artery of the dura mater to enter.

4. The point of this spinous process projects in the form of a very small peak, which will hardly be found by the student. It projects from the basis of the skull just within the condyle of the lower jaw; and being a small point, like the point of the stilus, or iron pen, it also is named STYLOID PROCESS, and gives rise to a curious muscle of the palate.

5. The PTERYGOID PROCESSES* are four in number, two on either side. They are those processes, upon which (with the spinous process) the bone naturally stands, and which, when we compare it with a bat, represent the legs; one of each side is named external pterygoid; the other is named the internal pterygoid process.

1. Each EXTERNAL PTERYGOID PROCESS, is thin, flat, and broad, and extends further backwards. Each INTERNAL PTERYGOID process is taller and more slender; not so flat nor broad. It has its end rising higher than the other, and tipped with a small neat hook, named the hook of the pterygoid process. The inner pterygoid processes form the back of the nostrils. The Eustachian tube comes downwards in a wide groove betwixt the two processes, and then turning its wide mouth towards the nostril, it opens just behind the internal process, viz. behind the nostril, and over the back of the palate. The hook of the pterygoid process is called the hook of the palate, of which it forms the backmost point. The musculus circumflexus vel tensor palati, rising from the mouth of the Eustachian tube, turns with a small tendon round this hook, like a rope over its pulley; and the great muscles of the lower jaw, the only ones for moving it sidewise, or for its grinding motions, arise from the pterygoid processes, so as to be named the external and internal pterygoid muscles, according to the processes from which they arise.

6. The AZYGOUS PROCESS†, is so named, from its being single, because it is seated in the centre of the bone, so that it can have no fellow. It stands perpendicularly downwards and forwards, over the centre of the nose, and its chief use is to give a firm seat or insertion for the vomer, or bone, which forms the septum. This with the azygous process of the æthmoid bone united, forms the upper and back parts of the septum; and the vomer, or proper bone of the partition, stands, with a split edge, astride over these two processes, so as to have a very firm seat.

7. The CLYNOID PROCESSES, have, like many parts of the human body, a very whimsical name, very ill suited to express their form; for it is not easy, in this instance, to ac-

* There is some confusion in this name, since pterygoid signifies aliform, or wing-like processes.

† Azygous is a term, which is applied to such parts as have no fellow; because almost always the parts on one side of the body are balanced by similar and corresponding parts on the other side. When they stand in the centre of the body, or are otherwise single, we call them azygous; and so the azygous process of the æthmoid and sphenoid, and other bones; or the azygous vein, which runs in the centre of the thorax, and is single.

knowledge the likeness of four little knobs to bed-posts; yet the clynoid processes are very remarkable. The two ANTERIOR CLYNOID PROCESSES are small bumps, rather sharp, projecting backwards, and terminating in two flat projecting points. The POSTERIOR CLYNOID PROCESSES, rise about an inch further backwards, and are, as it were, opposed to the others. They rise in one broad and flat process, which divides above into two points, small and round, or knobby at their points; and they look forwards towards the anterior clynoid processes.

The SELLA TURCICA EPHIPPIUM, or Turkish saddle, is the space inclosed by these four processes, and is well named. The sella turcica supports the pituitary gland, an appendage of the brain, the use of which is unknown. The carotid arteries rise up by the sides of the sella turcica, and mark its sides with a broad groove. The optic nerves lie upon a groove at the fore part of the sella turcica, betwixt the two anterior clynoid processes; and sometimes the two anterior processes stretch backwards, till they meet the posterior ones, and form an arch, under which the carotid artery passes. Often the posterior clynoid knobs cannot be fairly distinguished; since, in many skulls, they form but one broad process.

This bone has also its cells, for all that part which we call the body of the bone, all the sella turcica, that space which is betwixt the clynoid processes within and the azygous process without, is hollowed into one large cell, divided with a middle partition. It is indeed less regular than the other cells; it is sometimes very large, sometimes it is not to be found; it has other trifling varieties, which it were idle to describe. As it communicates with the æthmoid cells, it probably performs one office with them; is almost a continuation of them, so that when any one is less or wanting, the others are proportionally larger.

HOLES.—The sphenoid bone is so placed in the very centre of the skull, that its holes transmit the principal nerves of the skull, and it bears the marks of the chief arteries.

1. The OPTIC HOLES, are large, round holes, just under each anterior clynoid process. We trace the optic nerves, by a large groove into each optic hole; and an artery goes along with them, named the ophthalmic artery, about the size of a crow-quill, twisting round the optic nerve, and giving arteries to the eyelids, muscles, and lachrymal gland, but most especially to the ball and humours of the eye itself. This ocular or ophthalmic artery comes off from the great carotid, while it lies by the side of the sella turcica; and it is a branch again of

this ocular artery, which goes out upon the forehead, forming the superciliary notch, or hole.

2. The FORAMEN LACERUM is next in order, and is so named, because it is a wide slit. The foramen lacerum is wide near the sella turcica, grows gradually narrower as it goes out towards the temple, till it terminates almost in a slit. The upper line of the foramen lacerum is formed by the anterior clynoid process, extending outwards, sharp and flat: And this is what some have chosen to distinguish by the name of TRANSVERSE SPINOUS PROCESS, or the little wing of Ingrasias, who had observed it.

The nerves of the skull are counted from before backwards. There are nine nerves proper to the skull; the first, or olfactory nerve, perforates the cribriform bone; the 2d, or optic nerve, passes through the optic hole; the 3d, the 4th, part of the 5th, and the whole of the 6th pairs of the nerves, pass through this foramen lacerum, or wide hole, to go also into the eye. The optic nerve forms the proper organ of vision. The smaller nerves of the 3d, 4th, 5th, and 6th pairs, go to animate its muscles, with the trifling exception of some small twigs, which, passing through the orbit, mount upon the forehead, or go downwards into the nose.

3. The FORAMEN ROTUNDUM, is named from its round shape. The foramen opticum is indeed round, but it has already got an appropriated name. Now to give the young anatomist a regular notion of this, and of the next hole, we must enumerate the branches of the 5th pair. The fifth nerve of the brain is as broad as the little finger, and lies by the side of the sella turcica, where it divides into the three lesser nerves, which are called branches of the 5th pair. The first branch of the 5th pair is destined for the eye; the second branch of the 5th pair for the upper jaw; the third branch of this 5th pair for the lower jaw: so the first branch of the 5th pair passes through the foramen lacerum to the eye; the second branch of the 5th pair passes through the foramen rotundum to the upper jaw; the third branch of this great nerve passes through the foramen ovale to the lower jaw; and if we had any faith in the doctrines of nervous sympathy, we should say, here is a wide sympathy provided among the nerves of the eye, the face, and the lower jaw.

The foramen rotundum, then, is a hole exactly round, pretty large, opening immediately under the inner end of the foramen lacerum, and transmitting the second branch of the 5th pair of nerves to the upper jaw.

4. The FORAMEN OVALE, is an oval hole, larger than the

foramen rotundum ; about half an inch behind it ; and transmitting the third branch of the 5th pair to the lower jaw.

5. The FORAMEN SPINALE, or SPINOUS HOLE, is a very small round hole, as if made with a large pin ; is in the very point of the spinous process ; is one third of an inch behind the oval hole, and transmits the small artery, less than a crow-quill, which constitutes the chief artery of the dura mater, viz. that artery which makes its impression upon the parietal bone.

6. There is still another hole, which transmits a nerve, curious in this respect, that it is not going out from the skull, but returning into it ; for the second branch of the 5th pair, or the superior maxillary nerve, sends a small branch backwards, which having come within the skull, enters the temporal bone, and goes to join itself to the portio dura of the 7th pair, and in its way gives a small branch, to help out the slender beginning of the great sympathetic nerve. This retrograde branch of the maxillary nerve gets back again into the skull, by a hole which is found, just under the root of each pterygoid process, whence it is named PTERYGOID HOLE* ; or by many, is named after its discoverer, the VIDIAN HOLE†. This hole is almost hidden under the point of the petrous bone, is not to be seen, but in the separated bones, and is nearly of the size of the spinous hole.

If there are found some minute holes about the sella turcica, they are only the marks of some blood-vessels, entering the bone to nourish it.

CHAP. IV.

OF THE BONES OF THE FACE AND JAWS.

THE face is composed of a great number of small bones, which are grouped together, under the common name of upper jaw. There are six bones on either side of the face ; but as their names could convey no distinct notion of the uses, forms, or places of these bones, to enumerate them were but waste of time : they have indeed sutures, and their sutures

* This retrograde twig, is the little nerve which perforates the os petrosum on its fore part. *Vide* page 43.

† Vidus Vidius, a professor of Paris, and physician to Francis the first.

have been very regularly enumerated; but these bones meet each other by such thin edges, that no indention nor proper suture is formed. None of these sutures run for any length, or are of any note; therefore I have only this to say concerning the sutures of the face, that they are acknowledged to be purely a consequence of the ossification having begun in many points: no particular design of nature has been supposed. The sutures, if they require names, are to be named after the bones which they unite.

OSSA NASI.—The ossa nasi are small bones, rather thin, having no cancelli, being merely firm and condensed plates. They are convex outwardly, so that the two together form nearly an arch. They are opposed to each other by a pretty broad surface, so that their thin arch is firm. They have a flat rough surface, by which they are laid upon the rough surface of the frontal bone; so that there also their connection is strong. They are inclosed by a branch of the upper jaw-bone, which stretching upwards, is named its nasal process: and they lie with their edges under it in one part, and above it in another, in such a way, that they cannot easily be forced in. Lastly, their lower edge is rough, for the firm attachment of the cartilages of the nose; and their lowest point, or that where the bones of the nose and the gristles of the nose are joined, is the most prominent point (or as it is vulgarly called the bridge) of the nose; from which connection, notwithstanding its firmness, the cartilages are sometimes luxated.

Os UNGUIS, so named from its being of the size and shape of a nail; or sometimes named the os LACHRYMALE, from its holding the duct which conveys the tears, is that thin scale of bone which I have described as belonging to the os æthmoides. It is commonly described as a distinct bone; it is a thin flat bone, a single scale, without any cancelli; it is found in the inner angle of the eye, at its forepart, and just touching the top of the nose; it has a large groove in it for holding the lachrymal sac and duct. One half of this bone is behind the groove, and there the eye rolls upon it. One half of it is occupied by the groove for the nasal duct; and the other side of the groove is formed by the rising branch, or nasal process, as it is called, of the upper jaw-bone. The os unguis is delicate, and easily broken, being as thin as a sheet of paper. It is this bone which is pierced in the operation for the fistula lachrymalis; which is easily done, almost with a blunt steel or probe; and the chief caution is to keep forwards, so as to perforate in the place of the groove, as that will lead into the nose, and not behind it, which would carry the perforating in-

strument into the æthmoidal sinuses, and perhaps wound the spongy bone.

This bone seems peculiarly liable to caries, which is perhaps the nature of all these thin bones; for as they have no marrow, they must depend entirely on their periosteum, which they are no sooner robbed of than they die.

OSSA MAXILLARIA SUPERIORA.—The upper jaw-bones are particularly worthy of notice; for here we find all that is curious in the face, even to its size and shape. The upper jaw-bones are of very great size, forming as it were the foundation or basis of the face. They send a large branch upwards, which forms the sides of the nose; a broad plate goes backwards, which forms the roof of the palate; there is a circular projection below, which forms the alveoli, or sockets of the teeth. The upper jaw-bones are quite hollow within, forming a very large cavity, which is capable of containing an ounce of fluid or more. The size of this cavity seems to determine the height of the cheek-bone, and the form of the face; and the diseased enlargement of this cavity raises the cheek bone, lessens the eye, and deforms the face in a very extraordinary degree.

These processes, and this cavity of the bone, are what deserve most particular notice.

1. The first is the NASAL PROCESS, which extends upwards, to form the side of the nose. It is arched outwards, to give the nostrils shape. Its sides support the nasal bones; and the cartilages of the alæ nasi, or wings of the nose, are fixed to the edges of this process.

2. A plate of this bone is called the orbitary process. This thin plate is the roof of the great cavity, which occupies this bone entirely. It is at once as a roof to the antrum maxillare, and as a floor for the eye to roll upon. There is a wide groove along the upper surface of this plate, in which the chief branch of the upper maxillary nerve lies; and this branch, named infra orbitary nerve from its lying thus under the eye, comes out by a hole of the jaw-bone under the eye, which is named infra orbitary hole. And thus the nerve appearing upon the cheek, is the chief nerve of the face.

3. This great bone is the basis upon which the cheek-bone stands; and that it may have a firm place, there is a rough and (as anatomists call it) scabrous surface, which makes a very firm suture with the cheek-bone; and as this surface rises a little, it is named the malar process.

4. From the lower circle of this bone, there projects a semicircle of bone, which is for lodging the teeth of the upper jaw. This circle of bone is as deep as the fangs of the teeth are

long. And it may be very truly named a process (PROCESSUS ALVEOLARIS,) since it does not exist in the fœtus, nor till the teeth begin to be formed; since it grows along with the teeth and is absorbed and carried clean away when in old age the teeth fall out. The sides of the sockets in which the teeth are lodged are extremely thin, and surround them closely. The teeth are so closely embraced by their sockets, and we are so far from being possessed of any instrument by which they can be pulled perpendicularly out, that the sockets can seldom escape; they are broken or splintered in perhaps one of four extractions, even by the most dexterous artists in that line.

5. The PALATE PROCESS is a plate of bone which divides the nose from the mouth, constituting the roof of the palate, and the floor or bottom of the nostrils. This plate is thinner in its middle, and thicker at either edge: thus, it is thick where it first comes off from the alveolar process; it is thin in its middle; and it is again thick where it meets its fellow of the opposite side. For at the place where the two upper jaw-bones meet, the palate plate is turned upwards, so that the two bones are opposed to each other in the middle of the palate, by a broad flat surface, which cannot be seen but by separating the bones. This surface is so very rough, that the middle palate suture almost resembles the sutures of the skull; and the maxillary bones are neither easily separated, nor easily joined again. This meeting of the palate plates by a broad surface, makes a rising spine, or sharp ridge towards the nostrils; so that the broadness of the surface by which these bones meet, serves a double purpose; it joins the bones securely, and it forms a small ridge upon which the split edge of the vomer, or partition of the nose, is planted. Thus we find the palate plate of the maxillary bones conjoined; forming almost the whole of the palate, while what are properly called the palate bones form a very small share of the back part only. As these thinner bones of the face have no marrow, they are nourished by their periosteum only; they are of course perforated with many small holes. A great many minute holes are found along the palate plate, about the place of the sockets, and indeed all over the maxillary bones; and this is particular in the palate, that the hard membrane or covering of it, is fixed to the bony plate by many rough tubercles, and even by small hooks, which are easily seen in the dried bone.

6. The ANTRUM MAXILLARE, or cavity of the jaw-bone, is commonly named ANTRUM HIGHMORIANUM, after its discover Highmore. We have gone round the antrum, on all its sides, in describing these processes of the bone: the palate plate makes the floor of the antrum; the orbitary process

makes its roof; the cheek, quite up from the socket of the teeth to the lower part of the eye, forms its walls, or sides; so that when the antrum enlarges, it is the cheek that becomes deformed; and when we design to open the antrum, we either perforate the cheek, or pull one of the teeth. The antrum is concave towards the cheek, but it has a flat side towards the nose; it is divided from the cavity of the nostril by a flat and very thin plate of bone; it seems in the naked skull to have a very wide opening, and the lower spongy bone is hung by a small hook upon the edge of this thin septum, which divides the antrum from the nose; but in the skull, covered with its soft parts, we find the antrum almost closed by a membrane which stretches over the opening, and leaves but one or two very small holes of the size of the smallest pea, by which, perhaps, the reverberation of sound in the antrum is more effectual in raising the voice, and by which small hole, the mucus, which is secreted in the antrum, drops out into the nose. The cavity of the antrum, like the inner surfaces of the nostrils, is covered with a membrane, and is bedewed with mucus; and the mucus drops more or less freely in various positions of the head. Sometimes by cold or other accidents, inflammations and swellings of the membrane come on; the holes are closed; the drain of matter is suppressed and confined within, and the cheek swells. Perhaps there may be some particular disease of the membrane with which the cavity is lined, or of the bone itself; in one way or other, diseases of this cavity, and collections of matter, dreadful pain and caries of the bone are very frequent; then the cheek rises; the face is irrecoverably deformed; sometimes the matter makes its way by the sides of the teeth, or at last, it bursts through the bones, makes an ulcer in the cheek; and then there is a natural cure, but slow and uncertain. There is no very sure mark of this disease; it may be known by an attentive retrospect of all the circumstances. The disease is not to be easily nor certainly discovered; but a very long continued toothach, an uncommon degree of pain, or greater affection of the eye, with a swelling and redness, and gradual rising of the cheek, are very suspicious signs. The pulling of the second or third of the grinding teeth, often brings a splinter away with it, which opens a road for the matter to flow; or though there be no breach of the socket, often the confined matter follows the teeth, because not unfrequently the longer fangs of the grinders naturally penetrate quite into this cavity of the jaw: if the matter should not flow, the floor of the antrum is easily perforated, by introducing a sharp stillet by the socket of the tooth that is pulled. The flow of the matter

gives relief, and injections of various medicines, complete the cure. But as this opening is sometimes a cure, it is sometimes also a disease; for the breaking of a socket, sometimes opening a way into this antrum, there follows inflammation of its internal surface, a running of matter, and sometimes caries of the bone.

HOLES.—The holes of the jaw-bone are two only: 1. The INFRA-ORBITARY hole, for transmitting the infra-orbitary nerve from the bottom of the eye, comes along under the eye in a bony groove, and makes generally one large round hole on the cheek, just under the margin of the orbit, or sometimes the nerve divides and makes two smaller holes in its passage upon the cheek; and, 2. A hole in the palate plate, which belongs equally to each of the palate bones; for it is betwixt the two bones in the forepart, or beginning of the palate suture behind the two first cutting teeth. This hole is named FORAMEN INCISIVUM, as opening just behind the incisive or cutting teeth; or it is named ANTERIOR PALATINE HOLE, to distinguish it from one in the back of the palate: this hole is large enough to receive the point of a quill; it is single towards the mouth; but towards the nose, it has two large openings, one opening distinctly into each nostril.

3. But it will be well to explain here a third hole, which is common to the maxillary with the proper palate bones. It is formed on the back part of the palate (one on either side), in the suture which joins the palate bones to the jaw-bones: it is named POSTERIOR PALATINE HOLE: it is as large as the interior palatine hole, but it serves a much more important purpose; for the upper maxillary nerve sends a large branch to the palate, which branch comes down behind the back of the nostril, perforates the back of the palate, by the posterior palatine hole, and then goes forward in two great branches along the palate. Thus the chief, or, we might say, the only nerves of the palate come down to it through these posterior palatine holes; but the use of the anterior palatine hole is a problem still; for we cannot believe that so great a hole, so very regular, and so curiously divided, so as to open into the two nostrils, can be quite useless; yet the meaning of this hole has never been explained. It looks almost as if it were merely designed for giving the soft palate a surer hold upon the bone; for no ducts have been found opening into the palate from the nose; nor any glands with their ducts seated here; nor any nerves passing either from the nose to the palate, or from the palate to the nose; nor any artery, except one of the most trifling size. In short, anatomists having sought with care for

any thing that might explain its use, have still found nothing but the hard membrane filling up the anterior hole.

The whole surface of the bone which forms the antrum, is perforated with frequent small holes, especially towards its back part, transmitting small arteries and nerves to the teeth; and the back of the antrum forms with the orbitary part of the sphenoid bone a second foramen lacerum for the eye; an irregular opening towards the bottom of the socket, which is for the accumulation of fat, not for the transmission of nerves; and it is from the wasting of this fat, taken back into the system, that the eye sinks so remarkably in fevers, consumptions, and such other diseases as waste the body.

The OSSA PALATI, or PALATE BONES—are very small, but have such a number of parts, and such curious connections as are not easily explained. They seem to eke out the superior maxillary bones, so as to lengthen the palate, and complete the nostrils behind: they even extend upwards into the socket, so as to form a part of its circle; although, in looking for them upon the entire skull, all these parts are so hidden, that we should suppose the palate bones to be of no greater use nor extent than to lengthen the palate a little backwards.

The parts of the palate bone are these:

1. The PALATAL PLATE, or process of the palate bone, whence it has it name, lies horizontal in the same level with the palatal process of the jaw-bone, which it resembles in its rough and spinous surface; in its thinness; in its being thinner in the middle, and thicker at either end; in its being opposed to its fellow by a broad surface, which completes the MIDDLE PALATE SUTURE; and it is connected with the palate process of the jaw, by a suture resembling that by which the opposite bones are joined; but this suture going across the back part of the palate, is named the TRANSVERSE PALATE SUTURE. Where the two palate bones are joined, they run backwards into an acute point; on either side of that middle point, they make a semicircular line, and again run out into two points behind the grinding teeth of each side. By this figure of the bones, the back line of the palate has a scolloped or waved form. The velum palati, or curtain of the palate, is a little arched, following the general line of the bones; the uvula or pap hangs exactly from the middle of the velum, taking its origin from the middle projecting point of the two bones; and a small muscle, the azygus uvulæ, runs down in the middle of the velum, taking its origin from the middle point.

2. The small projecting point of the palate bone, just behind the last grinding tooth, touches the pterygoid process of

the sphenoid bone; it is therefore named the PTERYGOID PROCESS of the palate bone; but it is so joined with the pterygoid process of the sphenoidal bone, that they are not to be distinguished in the entire skull. The posterior pterygoid hole, or third hole of the palate, is just before this point.

3. The NASAL PLATE OR PROCESS, is a thin and single plate; rises perpendicularly upwards from the palate; lies upon the side and back part of the nostrils, so as to form their opening backwards into the throat; it is so joined to the upper jaw-bone, that it lies there like a sounding-board upon the side of the antrum Highmorianum, and completes that cavity forming the thin partition betwixt it and the nose.

4. This nasal process extends thus up from the back arch of the palate to the back part of the orbit; and though the nasal plate is very thin and delicate in its whole length, yet, where it enters into the orbit, it is enlarged into an irregular kind of knob of a triangular form. This knob is named its ORBITARY PROCESS; or, as the knob has two faces looking two ways in the orbit, it is divided sometimes (as by Monro the father) into two orbitary processes, the anterior and posterior; the anterior one is the chief. This orbitary process, or point of the palate bone, being triangular, very small, and very deep in the socket, is not easily discovered in the entire skull.

5. This orbitary process is most commonly hollow or cellular, and its cells are so joined to those of the sphenoid bone, that it is the palate bone that shuts the sphenoid cells, and the sphenoid and PALATINE CELLS of each side constitute but one general cavity.

The OSSA SPONGIOSA, or TURBINATA, INFERIORA, are so named to distinguish them from the upper spongy bones, which belong to the os æthmoides; but these lower spongy bones are quite distinct, formed apart, and connected in a very slight way with the upper jaw-bones.

The OSSA SPONGIOSA INFERIORA, are two bones, much rolled or convoluted; very spongy; of a light and scaly appearance, with holes and an appearance of net-work resembling the sponginess of puffed paste, so that they are exceedingly light. They lie rolled up in the lower part of the nose; are particularly large in sheep; are easily seen either in the entire subject, or in the naked skull. Their point forms that projection, which is touched with the finger in picking the nose; and from that indecent practice, very often serious consequences arise, for in many instances, polypi of the lower spongy

bones, which can be fairly traced to hurts of this kind, grow so, as to extend down the throat, causing suffocation and death.

One membrane constitutes the universal lining of the cavities of the nose, and the coverings of all the spongy bones. This continuity of the membrane, prevents our seeing in the subject, how slightly the spongy bones are hung; but in the bare and dissected skull, we find a neat small HOOK upon the spongy bone, by which it is hung upon the edge of the antrum maxillare; for this lower spongy bone is laid upon the side of the antrum so as to help the palate bone, in closing or covering that cavity from within. One END of the spongy bone, rather more acute, is turned towards the opening of the nostril, and covers the end of the lachrymal duct: the other END of the same bone, points backwards towards the throat. The curling plate, hangs down into the cavity of the nostril, with its arched side towards the nose. This spongy bone differs from the spongy process of the æthmoid bone, in being less turbinated or complex; in having no cells connected with it; and perhaps it is less directly related to the organ of smell. If polypi arise from the upper spongy bone, we can use less freedom, and dare hardly pull them away, for fear of injuring the cribriform plate of the æthmoid bone: we are indeed not absolutely prohibited from pulling the polypi from the upper spongy bone: but we are more at ease, in pulling them from the lower one, since it is quite an insulated bone. When peas, or any such foreign bodies, are detained in the nose, it must be from their swelling and being detained among the spongy bones.

The spongy bones are not absolutely limited in their number: there is sometimes found betwixt these two, a third set of small turbinated bones, commonly belonging to the æthmoid bone.

VOMER.—The nose is completed by the vomer, which is named from its resemblance to a ploughshare, and which divides the two nostrils from each other. It is a thin and slender bone, consisting evidently of two plates much compressed together; very dense and strong; but still so thin as to be transparent. The two plates of which the vomer is composed, split or part from each other at every edge of it, so as to form a groove on every side. 1. On its upper part, or as we may call it, its base, by which it stands upon its skull, the vomer has a WIDE GROOVE, receiving the projecting point of the æthmoid and sphenoid bones: thus it stands very firm and secure, and capable of resisting very violent blows. 2. Upon its lower part, its groove is narrower, and receives the rising line in the middle of the palate plate, where the bones meet, to form the

palate suture. At its forepart, it is united by a ragged surface, and by something like a groove, to the middle cartilage of the nose; and as the vomer receives the other bones into its grooves, it is, in a manner, locked in on all sides: it receives support and strength from each; and if the vomer and its cartilage should seem too slender a support for the fabric of the nose, let it be remembered, that they are all firmly connected, and covered by one continuous membrane, which is thick and strong, and that this is as a periosteum, or rather like a continued ligament, which increases greatly the thickness and the strength of every one of these thin plates. The vomer, in almost every subject, bends much towards one or other nostril, so as sometimes to occasion no small apprehension, when it happens to be first observed.

OS MALÆ, or the bone of the cheek, is easily known, and is a very unimportant one. It is that large square bone which forms the cheek: it has four distinct points, which anatomists have chosen to demonstrate, with a very superfluous accuracy. 1. The UPPER ORBITARY process stands highest, running upwards to form part of the socket, the outer corner of the eye, and the sharp edge of the temple. 2. The INFERIOR ORBITARY PROCESS, which is just opposite to this, forming the lower part of the orbit, and the edge of the cheek. 3. The MAXILLARY PROCESS, is that broad and rough surface, by which it is joined to the upper jaw-bone. 4. There is another process, the best entitled to the name of process, because it stands out quite insulated, and goes outwards and backwards to unite with the temporal bone, in forming the zygoma or temporal arch; it is named the ZYGOMATIC PROCESS. 5. That plate, which goes backwards to form the floor of the orbit, is named the INTERNAL ORBITARY PROCESS. This bone has no holes, except such minute ones as transmit arteries, merely for the nourishment of the bone itself.

OS MAXILLÆ INFERIORIS.—The lower jaw-bone, is likened to a horse-shoe, or to a crescent, or to the letter U, though we need be under no anxiety about resemblances for a form so generally known. There is such an infinite complication of parts surrounding the jaw, of glands, muscles, blood-vessels, and nerves, that it were endless to give even the slightest account of these. They shall be reserved each for its proper place, while I explain the form of the lower jaw, in the most simple and easy way.

1. The forepart, or chin, is, in a handsome and manly face, very square; and this portion is marked out by this square-

ness, and by two small holes, one on either side, by which the nerves of the lower jaw come out upon the face.

2. The base of the jaw, is a straight and even line, terminating the outline of the face. It is distinctly traced all along, from the first point of the chin, backwards to the angle of the jaw. Fractures of this bone are always more or less transverse, and are easily known by the falling down of one part of this even line, and by feeling the crashing bones when the fallen part is raised. Such fractures happen from blows or falls; but not by pulling teeth, for the sockets of the teeth bear but a small proportion to the rest of the jaw: even in children this cannot happen, for in them the teeth have no roots, and have no hold nor dangerous power over the jaw. Though (as I have said) the sockets often suffer, the jaw itself never yields.

3. The angle of the jaw, is that corner where the base of the jaw ends, where the bone rises upwards, at right angles, to be articulated with the head. This part also is easily felt, and by it we judge well of the situation of veins, arteries, and glands, which might be in danger of being cut, in wounds or in operations. There are two processes of the jaw, of particular importance, the coronoid or horn-like process, for the insertion of its strong muscles, especially of the temporal muscle, and the condyloid or hinge process, by which it is jointed with the temporal bone.

4. The CORONOID PROCESS, named from its resemblance to a horn, is, like the rest of the jaw-bone, flat on its sides, and turned up with an acute angle, very sharp at its point, and lying exactly under the zygoma, or temporal arch. The temporal muscle runs under this arch, and lays hold on the coronoid process; not touching it on one point only, but grasping it on every side, and all round. And the process is set so far before the articulation of the jaw, that it gives the muscle great power. This process is so defended by the temporal arch, and so covered by muscles, that it cannot be felt without.

5. The CONDYLOID PROCESS, or the articulating process of the jaw, is behind this, and is formed by the body of the bone turned up at its angle. This also is of the same flat form with the rest of the jaw. The condyle, or joint of the jaw-bone, is placed upon the top of this rising branch. The condyle, or articulating head, is not round, but flat, of a long form, and set across the branch of the jaw. This articulating process is received into a long hollow of the temporal bone, just under the root of the zygomatic process; so that by the long form of the condyles, and of the cavity into which it is received, this joint is a mere hinge, not admitting of lateral nor rotatory motions,

at least of no wider lateral motions than those which are necessary in grinding the food; but the hinge of the jaw is a complex and very curious one, which shall be explained in its proper place.

6. The ALVEOLAR PROCESS, or the long range of sockets for the teeth, resembles that of the upper jaw. The jaw, as the body grows, is slowly increasing in length, and the teeth are added in proportion to the growth of the jaws. When the jaws have acquired their full size, the sockets are completely filled; the lips are extended, and the mouth is truly formed. In the decline of life, the teeth fall out, and the sockets are reabsorbed, and carried clean away, as if they had never been; so that the chin projects, the cheeks become hollow, and the lips fall in, the surest marks of old age.

The successive changes of the form of the jaw are worthy of being mentioned once more; first, That in the child, the jaw consists of two bones, which are joined slightly together in the chin. This joining, or symphysis, as it is called, is easily hurt, so that in preternatural labours it is, according to the common method of pulling by the chin, always in danger, and often broken. During childhood the processes are blunt, and short, do not turn upwards with a bold and acute angle, but go off obliquely from the body of the bone. The teeth are not rooted, but sticking superficially in the alveolar process; and another set lies under them, ready to push them from the jaws.

Secondly, That in youth, the alveolar process is extending, the teeth are increasing in number. The coronoid and articulating processes are growing acute and large, and are set off at right angles from the bone. The teeth are now firmly rooted; for the second set has come up from the substance of the jaw.

Thirdly, In manhood, the alveolar process is still more elongated. The dentes sapientiæ are added to the number of the teeth; but often, by this, the jaw is too full, and this last tooth coming up from the backmost part of the alveolar process in either jaw, it sometimes happens, that the jaw cannot easily close; the new tooth gives pain; it either corrupts, or it needs to be drawn.

Fourthly, In old age, the jaw once more falls flat; it shrinks according to the judgment by the eye, to half its size; the sockets are absorbed, and conveyed away; and in old age the coronoid process rises at a more acute angle from the skull, and by the falling down of the alveolar process, the coronoid process seems increased in length.

HOLES.—The holes of the lower jaw-bone are chiefly two.

1. A LARGE HOLE on the inner side, and above the angle of the jaw, just at the point where these two branches, the condyloid and the coronoid processes part. A wide groove from above downwards, leads to the hole; and the hole is, as it were, defended by a small point, or pike of bone, rising up from its margin. This is the GREAT HOLE for admitting the LOWER MAXILLARY NERVE into the hollow of the jaw, where it goes round within the circle of the jaw, distributing its nerves to all the teeth. But at the point where this chief branch of the nerve goes down into the jaw, another branch of the nerve goes forward to the tongue. And as nerves make an impression as deep as that of arteries in a bone, we find here two grooves, first, One marking the place of the great nerve, as it advances towards its hole; and, secondly, A smaller groove, marking the course of the lesser branch, as it leaves the trunk, and passes this hole to go forward to the tongue.

Along with this nerve, the lower maxillary artery, a large branch, enters also by the hole; and both the nerve and artery, after having gone round the canal of the jaw, emerge again upon the chin.

2. The second hole of the lower jaw is that on the side of the chin, about an inch from the point which permits the remains of the great nerve and artery (almost expended upon the teeth) to come out upon the chin; it is named the MENTAL HOLE.

CHAP. V.

OF THE TRUNK.

OR,

THE SPINE, THORAX, AND PELVIS.

THE SPINE.

THE spine is so named from certain projecting points of each bone, which standing outwards in the back, form a continued ridge; and the appearance of continuity is so com-

plete, that the whole ridge is named spine, which, in common language, is spoken of as a single bone. This long line consists of twenty-four distinct bones, named vertebræ, from the Latin vertere, to turn. They conduct the spinal marrow, secure from harm, the whole length of the spine; and support the whole weight of the trunk, head and arms; they perform at certain points, the chief turnings and bendings of the body; and do not suffer under the longest fatigue, or the greatest weight which the limbs can bear. Hardly can any thing be more beautiful or surprising than this mechanism of the spine, where nature has established the most opposite and inconsistent functions in one set of bones; for these bones are so free in motion, as to turn continually, yet so strong as to support the whole weight of the body; and so flexible as to turn quickly in all directions, yet so steady within, as to contain and defend the most material and the most delicate part of the nervous system.

The vertebræ are arranged according to the neck, back, and loins, and the number of pieces corresponds with the length of these divisions. The vertebræ of the LOINS are five in number, very large and strong, and bearing the whole weight of the body. Their processes stand out very wide and free, not entangled with each other; and perform the chief motions of the trunk. The vertebræ of the back are twelve in number. They also are big and strong, yet smaller than those of the loins; their processes are laid over each other; each bone is locked in with the next, and embarrassed by its connection with the ribs; this is therefore the steadiest part of the spine, a very limited motion only is allowed. The vertebræ of the NECK are seven in number; they are more simple, and like rings; their processes hardly project; they are very loose and free; and their motions are the widest and easiest of all the spine.

The seven vertebræ of the neck, twelve of the back, and five of the loins, make twenty-four in all, which is the regular proportion of the spine. But the number sometimes varies according to the proportions of the body; for where the loins are long, there are six vertebræ of the loins, and but eleven in the back; or the number of the pieces in the back is sometimes increased to thirteen; or the neck, according as it is long or short, sometimes has eight pieces, or sometimes only six.

GENERAL DESCRIPTION OF A VERTEBRA.—The general form, processes, and parts of the vertebra, are best exemplified in a vertebra of the loins; for in it the body is large, the

processes are right lined, large, and strong; the joint is complete, and all its parts are very strongly marked. Every vertebra consists of a body, which is firm for supporting the weight of the body, and hollow behind, for transmitting the spinal marrow; of two articulating processes above, and two below, by which it is jointed with the bones which are above and below it; of two transverse processes, which stand out from either side of the bone, to give hold and purchase to those muscles which turn the spine; and of one process, the spinous process, which stands directly backwards from the middle of the bone; and these processes being felt in distinct points all the way down the back, give the whole the appearance of a ridge; whence it has the name of spine.

1. The BODY of the VERTEBRA is a large mass of soft and spongy bone; it is circular before, and flat upon the sides. It is hollowed into the form of a crescent behind, to give the shape of that tube in which the spinal marrow is contained. The body has but a very thin scaly covering for its thick and spongy substance. It is tipped with a harder and prominent ring above and below, as a sort of defence, and within the ring the body of the vertebra is hollowed out into a sort of superficial cup, which receives the ligamentous substance by which the two next vertebræ are joined to it; so that each vertebra goes upon a pivot, resembles the ball and socket-joints; and in many animals it is distinctly a joint of this kind.

1. The BODY is the main part of the vertebra to which all the other processes are to be referred; it is the centre of the spine, and bears chiefly the weight of the body: it is large in the loins, where the weight of the whole rests upon it, and where the movements are rather free: it is smaller in the vertebræ of the back, where there is almost no motion, and less weight; and in the vertebræ of the neck, there is hardly any body; the vertebræ being joined to each other chiefly by the articulating processes.

2. The ARTICULATING PROCESS is a small projection, standing out obliquely from the body of the vertebra, with a smooth surface, by which it is joined to the articulating process of the next bone; for each vertebra has a double articulation; with that above and with that below. The bodies of the vertebræ are united to each other by a kind of ligament, which forms a more fixed, and rather an elastic joining; and they are united again by the articulating processes; which makes a very moveable joint of the common form. The articulating processes are sometimes named oblique processes, because they stand rather obliquely. The upper ones are named the ascending oblique processes, and the two lower ones are named the inferior or descending oblique processes.

3. The SPINOUS PROCESSES are those which project directly backwards, whose points form the ridge of the back, and whose sharpness gives the name to the whole column. The body of each vertebra sends out two arms, which, meeting behind, form an arch or canal for the spinal marrow; and from the middle of that arch, and opposite to the body, the spinous process projects. Now these spinous, and the transverse processes, are so many handles and levers by which the spine is to be moved: which, by their bigness, give a firm hold to the muscles; and, by their length, give them a powerful lever to work their effects by. The spinous processes, then, are for the insertion of these muscles which extend and raise the spine.

4. The TRANSVERSE PROCESSES stand out from the sides of the arms or branches which form this arch. They stand out at right angles, or transversely from the body of the bone; and they also are as levers, and long and powerful ones for moving and turning the spine. Perhaps their chief use is not for turning the vertebræ; for there is no provision for much of a lateral motion in the lower part of the spine, but the muscles which are implanted into these are more commonly used in assisting those which extend and raise the spine.

These, and all the processes, are more distinct, prominent, and strong, more direct, and larger in the loins, and more easily understood, than in the vertebræ of any other class. But this prepares only for the description of the individual vertebræ, where we find a variety proportioned to the various offices, and to the degrees of motion which each class has to perform.

OF THE VERTEBRÆ OF THE LOINS.—I have chosen to represent the general form of a vertebra, by describing one from the loins, because of the distinctness with which all its parts are marked. In the lumbar vertebræ, the perpendicular height of the body is short; the intervertebral substance is thicker than in the other parts of the spine: and the several processes stand off from each other distinct and clear; all which are provisions for a freer motion in the loins.

The BODY of a lumbar vertebra is particularly large, thick, and spongy; and its thin outer plate is perforated by many arteries going inwards to nourish this spongy substance of the bone. The length of the body is an inch, and the intersticial cartilage is nearly as long: so that the vertebræ of the loins present to the eye, looking from within the body, a large thick and massy column, fit for supporting so great a weight.

The SPINOUS PROCESS is short, big, and strong. It runs horizontally and directly backwards from the arch of the spinal marrow. It is flattened, and about an inch in breadth; and it is commonly terminated by a lump or knob, indicating the great strength of the muscles which belong to it, and the secure hold which they have.

The TRANSVERSE PROCESS is also short, direct, and very strong; going off horizontally from the side of the bone; terminated like the spinous, by a knotty point, where large muscles are implanted.

The ARTICULATING PROCESSES of the lumbar vertebræ stand so directly upwards and downwards, that the name of oblique processes cannot be applied here.

Of the VERTEBRÆ OF THE BACK.—The character of the vertebræ of the back is directly opposite to that of the loins. The BODIES of the vertebræ are still large to support the great weight of the trunk; but they are much longer than in the loins, and their intervertebral substance is thin, for there is little motion here. The SPINOUS PROCESSES in the vertebræ of the back, are very long and aquiline. They are broad at their basis, and very small or spinous at their further end; and in place of standing perpendicularly out from the body, they are so bent down, that they do not form a prominent nor unsightly spine, but are ranged almost in a perpendicular line; that is, laid over each other, like the scales of armour, the one above touching the one below, by which the motions of these vertebræ are still further abridged. And, lastly, the TRANSVERSE PROCESSES, which are short and knobby, in place of standing free and clear out, like those of the loins, are trammelled and restricted from motion, by their connexion with the ribs; for the ribs are not merely implanted upon the bodies of the dorsal vertebræ, but they are further attached firmly by ligaments, and by a regular joint to the transverse process of each vertebra. Now the rib being fixed to the body of one vertebra, and to the transverse process of the vertebra below, the motions of the vertebræ are much curbed. And we also get another mark by which the dorsal vertebræ may be known, viz. that each vertebra bears two impressions of the rib that was joined to it, one on the flat side of its body, and the other on the forepart of its transverse process.

Of the VERTEBRÆ OF THE NECK.—The vertebræ of the neck depart still farther from the common form. Their BODIES are flattened on their foreparts, so as to make a flat surface on which the windpipe and gullet lie smooth. The BODY is very

small in all the vertebræ of the neck. In the uppermost of the neck there is absolutely no body; and the next to that has not a body of the regular and common form. There is not in the vertebræ of the neck, as in those of the loins, a cup or hollow for receiving the intervertebral substance, but the surfaces of the body are flat or plain, and the articulating processes are oblique, and make as it were one articulation with the body; for the lower surface of the body being not hollow, but plain, and inclined forwards, and the articulating processes being also plain, and inclined backwards, the two surfaces are opposed to each other, and the one prevents the vertebræ from sliding forwards, and the other prevents it from sliding backwards, while a pretty free and general motion is allowed. The SPINOUS PROCESSES of the neck are for the insertion of many muscles, and therefore they are split. This bifurcation of the spinous process is not absolutely peculiar to the cervical vertebræ; for sometimes, though rarely, the others are so: and it is only in the middle of the neck that even they are forked; for the first vertebra is a plain ring, without any transverse process, because there are few muscles attached to it; and the last vertebra of the neck is scarcely bifurcated, approaching to the nature of the dorsal vertebræ; for it is long and aquiline; is depressed towards the back, and is so much longer than the others, as to be distinguished by the name of VERTEBRA PROMINENS.

The TRANSVERSE PROCESSES of the neck are also bifurcated, because there are a great many small muscles inserted into them also. But the most curious peculiarity of the transverse processes is, that each of them is perforated for the transmission of the great artery, which is named VERTEBRAL ARTERY, because it passes through these holes in the vertebræ which form altogether a bony canal for the artery. This artery, which is defended with so much care, is one of the chief arteries of the brain, for there are two only; and often when the other, the carotid, has been obstructed, this continues to perform its office.

So that the character of these cervical vertebræ is, that they are calculated for much free motion: and the marks by which they are distinguished are, that the bodies are particularly small; the articulating processes oblique, with regard to their position, and almost plain on their surface: the spinous process, which is wanting in the uppermost vertebra, is short and forked in all the lower ones; the transverse process also is forked; and the transverse processes of all the vertebræ, except perhaps the first, are perforated near their extremities with the large hole of the vertebral artery.

ATLAS AND DENTATUS.—But among these vertebræ of the neck, two are to be particularly distinguished, as of greater importance than all the rest; for though the five lower vertebræ of the neck be ossified and fixed, if but the two uppermost remain free, the head, and even the neck, seems to move with perfect ease.

The first vertebra is named ATLAS, perhaps, because the globe of the head is immediately placed upon it; the second is named DENTATUS, or axis, because it has an axis or tooth-like process upon which the first turns.

The ATLAS has not the complete form of the other vertebræ of the neck, for its processes are scarcely distinguishable: it has no body, unless its two articulating processes are to be reckoned as a body: it is no more than a simple ring; it has no spinous process; and its transverse process is not forked. The BODY is entirely wanting: in its place, the vertebra has a flat surface looking backwards, which is smooth and polished by the rolling of the tooth-like process; there is also a sharp point rising perpendicularly upwards towards the occipital bone, and this point is held to the edge of the occipital hole by a strong ligament. The smooth mark of the tooth-like process is easily found; and upon either side of it there projects a small point from the inner circle of the ring. These two points have a ligament extended betwixt them, called the transverse ligament; which, like a bridge, divides the ring into two openings; one, the smaller, for lodging the tooth-like process, embracing it closely; the greater opening is for the spinal marrow: the ligament confines the tooth-like process; and when the ligament is burst by violence, (as has happened,) the tooth-like process, broken loose, presses upon the spinal marrow; the head, no longer supported by it, falls forward, and the patient dies.

The ARTICULATING PROCESS may be considered as the body of this vertebra; for it is at once the only thick part, and the only articulating surface. This broad articulating substance is in the middle of each side of the ring: it has two smooth surfaces on each side, one looking upwards, by which it is joined to the occiput; and one looking directly downwards, by which it is joined to the second vertebra of the neck. The two upper articulating surfaces are oval, and slightly hollow to receive the occipital condyles: they are also oblique, for the inner margin of each dips downwards; the outer margin rises upwards; and the fore end of each oval is turned a little towards its fellow. Now, by the obliquity of the condyles, and this obliquity of the sockets which receive them, all rotatory motion is prevented; and the head performs, by its articulations with

the first vertebra or atlas, only the nodding motions; and when it rolls, it carries the first vertebra along with it, moving round the tooth-like process of the dentatus. The articulation with the head is a hinge joint in the strictest sense: it allows of no other motion than that backwards and forwards. The nodding motions are performed by the head upon the atlas; the rotatory motions are performed by the atlas moving along with the head, turning upon the tooth-like process of the dentatus.

Now the upper articulating surface of the atlas is hollowed to secure the articulation with the head; but the lower articulation, that with the dentatus, being secured already by the tooth-like process of that bone, no other property is required in the lower articulating surface of the atlas, than that it should glide with perfect ease: for which purpose it is plain and smooth; it neither receives, nor is received into the dentatus by any hollow, but lies flat upon the surface of that bone It is also evident, that since the office of the atlas is to turn along with the head, it could not be fixed to the dentatus, in the common way, by a body and by intervertebral substance: and since the atlas attached to the head moves along with it, turning as upon an axis, it must have no SPINOUS PROCESS: for the projection of a spinous process must have prevented its turning upon the dentatus, and would even have hindered, in some degree, the nodding of the head, therefore the atlas has a simple ring behind, and has only a small knob or button where the spinous process should be. The TRANSVERSE PROCESS is not forked, but it is perforated with a large hole for the vertebral artery; and the artery to get into the skull makes a wide turn, lying flat upon the bone, by which there is a slight hollow or impression of the artery, which makes the ring of the vertebra exceedingly thin.

But the form of the dentatus best explains these peculiarities of the atlas, and this turning of the head.

The DENTATUS or AXIS, is so named from its projecting point, which is the chief characteristic of this bone. When the dentatus is placed upright before us, we observe, 1. That it is most remarkably conical; rising all the way upwards, by a gradual slope, to the point of its tooth-like process. 2. That the ring of the vertebra is very deep, that is, very thick in its substance; and that the opening of the ring for transmitting the spinal marrow is of a triangular form. 3. That its spinous process is short, thick, and forked; and that it is turned much downwards, so as not to interfere, in any degree, with the rotation of the atlas. 4. That its tooth-like process, from which the bone is named, is very large, about an inch in length; very

thick, like the little finger; that it is pointed; and that from this rough point a strong ligament goes upwards, by which the tooth is tied to the great hole of the occipital bone. We also observe a neck or collar, or smaller part, near the root of the tooth-like process, where it is grasped by the ring of the atlas; while the point swells out a little above; so that without the help of ligaments it is almost locked in its place: we find this neck particularly smooth, for it is indeed upon this collar that the head continually turns. And, 5. We see on either side of this tooth-like process a broad and flat articulating surface, one on either side. These articulating surfaces are placed like shoulders; and the atlas being threaded by the tooth-like process of the dentatus, is set flat down upon the high shoulders of this bone, and there it turns and performs all the rotatory motions of the head.

OF THE MEDULLARY TUBE, AND THE PASSAGE OF THE NERVES.—All the vertebræ conjoined make a large canal of a triangular or roundish form, in which the spinal marrow lies, giving off and distributing its nerves to the neck, arms, and legs: and the whole course of the canal is rendered safe for the marrow, and very smooth by lining membranes; the outermost of which is of a leather-like strength and thickness, and serves this double purpose, that it is at once a hollow ligament, the whole length of the spine upon which the bones are threaded, and by which each individual bone is tied and fixed to the next; and it is also a vagina or sheath which contains the spinal marrow, and which is bedewed on its internal surface with a thin exudation, keeping the sheath moist and soft, and making the enclosed marrow lie easy and safe.

All down the spine this spinal medulla is giving off its nerves. One nerve passes from it at the interstice of each vertebra; so that there are twenty-four nerves of the spine; or rather forty-eight nerves, twenty-four being given towards each side. These nerves pass each through an opening or small hole in the general sheath, and then they pass through the interstice of each vertebra; so that there is no hole in the bone required, but the nerve escapes by going under the articulating process. This, indeed, is converted into something like a hole when the two contiguous vertebræ is joined to each other.

THE INTERVERTEBRAL SUBSTANCE.—The intervertebral substance is that which is interposed betwixt the bodies of two adjoining vertebræ, and which is (at least in the

loins) nearly equal in thickness to the body of the vertebra to which it belongs. We give it this undefined name, because there is nothing in the human system to which it is entirely similar; for it is not ligament, nor is it cartilage, but it is commonly defined to be something of an intermediate nature. It is a soft and pliant substance, which is curiously folded and returned upon itself, like a rolled bandage with folds, gradually softer towards the centre, and with the rolled edges as if cut obliquely into a sort of convex. The cut edges are thus turned towards the surface of the vertebra, to which the intervertebral substance belongs: it adheres to the face of each vertebra, and it is confined by a strong ligament all round. And this substance, though it still keeps its hold on each of the two vertebræ to which it belongs; though it permits no true motion of one bone on another, but only by a twisting of its substance; yields, nevertheless, easily to whichever side we incline, and returns in a moment to its place by a very powerful resilition. This perfect elasticity is the chief characteristic and virtue of this intervertebral substance; whose properties indeed are best explained by its uses; for in the bendings of the body, it yields in a very considerable degree, and rises on the moment that the weight or the force of the muscles is removed. In leaping, in shocks, or in falls, its elasticity prevents any harm to the spine, while other less important joints are luxated and destroyed. During the day, it is continually yielding under pressure; so that we are an inch taller in the morning than at night; we are shorter in old age than in youth; and the aged spine is bended forwards by the yielding of this part. These curious facts were first observed by a sort of chance, and have since been ascertained with particular care.

Since pressure, in length of years, shortens the forepart of the column of the spine, and makes the body stoop, any undue inclination to either side will cause distortion: the substance yields on one side, and rises on the other; and at last the same change happens in the bones also, and the distortion is fixed, and not to be changed. This is peculiarly apt to happen with children whose bones are growing, and whose gristles and intervertebral substances are peculiarly soft; so that a tumour on the head or jaw, which makes a boy carry his head on one side, or constant stooping, such as is used by a girl in working at the tambour, or the carrying of a weakly child always on one arm by a negligent or awkward nurse, will cause in time a fixed incurable distortion.

We are now qualified to understand the motions of the vertebræ, and to trace the degree of motion in each individual

class. The degrees of motion vary with the forms of the vertebra in each part of the spine: the motion is freest in the neck; more limited in the loins; and in the back (the middle part of the spine) scarcely any motion is allowed. The head performs all the nodding motions upon the first vertebra of the neck: the first vertebra of the neck performs again all the quick and short turnings of the head, by moving upon the dentatus: all the lower vertebræ of the neck are also tolerably free, and favour these motions by a degree of turning; and all the bendings of the neck are performed by them. The dorsal vertebræ are the most limited in their movements; bending chiefly forwards by the yielding of their intervertebral substance. The vertebræ of the loins again move largely, for their intervertebral substance is deep, and their processes quite unentangled and free. To perform these motions, each vertebra has two distinct joints, as different in office as in form: first, each vertebra is fixed to those above and below by the intervertebral substance, which adheres so to each that there is no true motion: there is no turning of any one vertebra upon the next; but the elasticity of the intervertebral substance allows the bones to move a little, so that there is a general twisting and gentle bending of the whole spine. The second joint is of the common nature with the other joints of the body, for the articulating processes are faced with cartilage, surrounded with a capsule, and lubricated with a mucus. And I conceive this to be the intention of the articulating processes being produced to such a length, that they may lap over each other to prevent luxations of the spine; and they must, of course, have these small joints, that they may yield to this general bending of the spine.

THORAX.

Of the ribs.—The ribs, whose office it is to give form to the thorax, and to cover and defend the lungs, also assist in breathing; for they are joined to the vertebræ by regular hinges, which allow of short motions, and to the sternum by cartilages, which yield to the motion of the ribs, and return again when the muscles cease to act.

Each rib, then, is characterised by these material parts: a great length of bone; at one end of which there is a head for articulation with the vertebræ, and a shoulder or knob for articulation with its transverse process; at the other end there is a point, with a socket for receiving its cartilage, and a cartilage joined to it, which is implanted into a similar socket

in the side of the sternum, so as to complete the form of the chest.

The ribs are twelve in number, according to the number of the vertebræ in the back. Of these seven are named true ribs, because their cartilages join directly with the sternum; and five are named false ribs, because their cartillages are not separately nor directly implanted into the sternum, but are joined one with another; the cartilage of the lower rib being joined, and lost in that of the rib above, so that all the lower ribs run into one greater cartilage. But there is still another distinction, viz. that the last rib, and commonly also the rib above, is not at all implanted in the sternum, but is loosely connected only with the muscles of the abdomen, whence it is named the loose or floating rib.

The ribs are, in general, of a flattened form, their flat sides being turned smooth towards the lungs. But this flatness of the rib is not regular; it is contorted, as if the soft rib had been seized by either end, and twisted betwixt the hands: the meaning of which is, to accommodate the flatness of the rib to the form which the thorax assumes in all its degrees of elevation; for when the rib rises, and during its rising through all the degrees of elevation, it still keeps its flat side towards the lungs. Though of a flattened form, the rib is a little rounded at its upper edge; is sharp and cutting at its lower edge; and its lower edge seems double, for there is a groove made there by the intercostal artery and nerve. They are named intercostal, from lying betwixt the ribs. The artery being rather within the rib, is defended in some degree by its groove; the lip of which forms the lower edge of the rib: but still this artery is not without reach of the knife, in some surgical operations. We are careful, therefore, to mark, that it runs on the lower edge of the rib, and is of the size of a crow-quill; and that, if it be wounded, it will bleed largely, from its nearness to the greatest artery of the body; that it is easily shunned, by keeping the knife nearer to the rib below.

On each rib we find the following parts: 1. The HEAD, or round knob by which it is joined to the spine. The head of each rib has indeed but a small articulating surface; but that smooth surface is double, or looks two ways. For the head of the rib is not implanted into the side of one vertebra; it is rather implanted into the interstice betwixt two vertebræ; the head touching both vertebræ; and each vertebra bearing the mark of two ribs, one above, and one below. The mark of the rib is on the edge of either vertebra, and the socket may be said to lie in the intervertebral substance betwixt them.

2. The NECK of the rib is a smaller part, immediately before the head. Here the rib is particularly small and round.

3. About an inch from the head, there is a second rising, or bump, the articulating surface, by which it touches and turns upon the transverse process. These two articulations have each a distinct capsule or bag; each is a very regular joint; and the degree of motion of the rib, and direction in which it moves, may be easily calculated, from the manner in which it is jointed with the spine. For the two articulating surfaces of the rib are on its back part; the back of the rib is simply laid upon the side of the spine; the joints, with the body of the vertebræ, and with its transverse process, are in one line, and form as if but one joint; so that the rib being fixed obliquely, and at one end only, that end continues firm, except in turning upon its axis; the two heads roll upon the body of the vertebræ, and upon the transverse process; and so its upper end continues fixed, while its lower end rises or falls; and as the motion is in a circle, the head being the central point, moves but little, while the lower end of the rib has the widest range.

4. Just above the second articulating surface, there is a third tubercle, which has nothing to do with the joints, but is intended merely for the attachment of the ligaments and muscles from the spine, which suspend and move the rib.

5. The angle of the rib is often mentioned, being a common mark for the place of surgical operations. There is a flatness of the thorax behind, forming the breadth of the back; the sharpness where this flatness begins to turn into the roundness of the chest, is formed by the angles of the ribs. Each rib is round in the place of its head, neck and tubercles: it grows flatter a little, as it approaches the angle; but it is not completely flattened till it has turned the angle which is the proper boundary betwixt the round and the flat parts of the rib.

It is very evident that this anatomy of the ribs is neither difficult nor important. It is in some degree useful, in the more advanced parts of anatomy, to remember the names; and it is necessary, even in speaking the common language of surgeons, to know these parts, viz. the head of the rib; the tubercle, or second articulating surface; the angle, or turning forward of the rib; the upper round, and the lower flat edge; and especially to remember the place and dangers of the intercostal artery. But there are some peculiarities in individual ribs; the chief of which are these: the size or length of the ribs gradually decreases from the first to the last, the first being exceedingly short and circular, the lower ones longer, and almost right-lined; so that the thorax is altogether of a conical shape, the upper opening so small, as just to per-

mit the trachea, œsophagus, and great vessels, to pass; the lower opening so large, that it equals the diameter of the abdomen: the first rib is consequently very short; it is thick, strong, and of a flattened form; of which flatness one face looks upwards, and another downwards: and the great axillary artery and vein lie upon its flat upper surface. It is also particularly circular, making more than half a circle from its head to the extremity, where it joins the sternum; it has, of course, no angle, and wants the distorted twisting of the other ribs. The second rib is also round, like the first rib. The eleventh and twelfth, or the floating ribs, are exceedingly small and delicate; and their cartilage terminates in an acute point, unconnected with the sternum. And, lastly, the heads of the first, and of the eleventh and twelfth ribs, are rounder than any of the others; for these three have their heads implanted into the flat side of one vertebra only; while all the others have theirs implanted betwixt the bodies of two vertebræ.

The cartilages of the ribs complete the form of the thorax, and form all the lunated edge of that cavity; and it is from this cartilaginous circle that the great muscle of the diaphragm has its chief origin, forming the partition betwixt the thorax and the abdomen. The farther end of each rib swells out thick and spongy, and has a small socket for lodging the cartilage; for these cartilages are not joined like the intervertebral substances with their bones; but there is a sort of joint very little moveable indeed, but still having a rude socket, and a strong capsular ligament, and being capable of luxation by falls and blows; and the implantations into the sternum are evidently by fair round sockets, which are easily distinguished upon the two edges of that bone. These cartilages may be enumerated thus: The cartilages of the first and second ribs descend to touch the sternum. The cartilage of the third rib is direct. The cartilages of the fourth, fifth and sixth ribs rise upwards, in proportion to their distance from this central one. The first five ribs have independent cartilages; the eighth, ninth and tenth ribs run their cartilages into the cartilage of the seventh rib; and the eleventh and twelfth ribs have their cartilages small, unconnected, and floating loose.

The sternum.—The sternum is that long and squared bone, which lies on the forepart of the breast over the heart, and which being joined by the cartilages of the ribs, completes the cavity of the chest; it is for completing the thorax, and defending the heart; for a medium of attachment to the ribs; and for a fulcrum or point, on which the clavicles may roll.

We find the sternum consisting in the child of eight distinct

pieces ; which run together in the progress of life ; and which in old age are firmly united into one : but in all the middle stage of life, we find three pieces in the sternum, two of which are properly bone, the third remains a cartilage till very late in life, and is named the ensiform cartilage, from its sword-like point.

It is found to have eight pieces, even in the child of six years old ; some years after, it has but five or six ; at last but two only ; and the salient white lines, which traverse the bone, mark where the intermediate cartilages have once been.

1. The upper piece of the sternum is very large, roundish, or rather triangular, resembling the form of the heart on playing cards. It is about two inches in length, and an inch and a half in breadth ; and these marks are easily observed ; the APEX, or point of the triangle, is pointed downwards, to meet the second bone of the sternum : the BASE OF THE TRIANGLE, which is uppermost, towards the root of the throat seems a little hollowed, for the trachea passing behind it : on each upper corner, it has a large articulating hollow, into which the ends of the collar bones are received ; (for this bone is the steady fulcrum upon which they roll). A little lower than this, and upon its side, is the socket for receiving the short cartilage of the first rib ; and the second rib is implanted in the interstice between the first and second bone of the sternum ; so that one half of the socket for its cartilage is found in the lower part of this bone, and the other half in the upper end of the next.

2. The second piece of the sternum is of a square form ; very long and flat ; and composing the chief length of the sternum : for the first piece receives only the cartilage of the first rib, and one half of the second ; but this long piece receives, on each side or edge of it, the cartilages of eight ribs ; but as three of the lower cartilages are run into one, there are but five sockets or marks. The sockets for receiving the cartilages of the ribs are on the edges of the sternum ; they are very deep in the firm substance of the bone, and large enough to receive the point of the finger with ease : and whoever compares the size and deepness of these sockets, with the round heads of the cartilages which enter into them, will no more doubt of distinct joints here, than of the distinct articulation of the vertebræ with each other.

3. This is in truth the whole of the bony sternum ; and what is reckoned the third piece, is a cartilage merely, and continues so down to extreme old age. This cartilage, which ekes out and lengthens the sternum, and which is pointed like a sword, is thence named CARTILAGO MUCRONATA, the pointed

cartilage; or CARTILAGO ENSIFORMIS, or XIPHOIDES, the sword-like cartilage. This cartilaginous point extending downwards over the belly, gives a sure origin, and greater power to the muscles of the abdomen; and that without embarrassing the motions of the body. But this cartilage, which is commonly short and single pointed, is sometimes forked; sometimes bent inwards, so (it has been thought) as to occasion sickness and pain; and in one case was found of such a length, as to reach the navel, and ossified at the same time, so as to hinder the bending of the body, and occasion much distress.

The sternum, and the ribs, and all the chest, stand so much exposed, that did we not naturally guard them with the hands, fractures must be very frequent; but indeed when they are broken and beaten in, they hurt the heart or lungs, and not unfrequently the most dreadful consequences ensue. I have already explained, that to this class of bones, defending the most noble viscera (next to the brain), the injuries are almost as fatal as injuries of the brain. Often by a wheel passing over the body, the sternum is broken; its pieces press inwards upon the heart, which is sometimes burst; but more commonly the patient dies a slow and miserable death; for the inflammation, which begins in the place of the wound, is extended to the lungs; is propagated still onwards to the heart; and the heart being once inflamed, there comes anxiety, oppression, faintings, and palpitations; anxious breathing; quick and interrupted pulse; still more frequent faintings, and then death. The ribs cover more properly the lungs; where the wound or inflammation is not always fatal: for the wound by the point of the rib is no deeper than just to puncture the lungs; yet through this small wound on their surface, the lungs breathe out their air into the cavity of the chest, and at last it escapes under the cellular substance of the skin; the man is blown up to a prodigious degree, with continually increasing anxiety: his breathing becomes more and more interrupted; and if not assisted, he must die.

PELVIS.

To give a steady bearing to the trunk, and to connect it with the lower extremities, by a sure and firm joining, the PELVIS is interposed. It is a circle of large and firm bones, standing as an arch betwixt the lower extremities and the trunk. Its arch is wide and strong, so as to give a firm bearing to the body; its individual bones are large, so as to give a deep and sure socket for the implantation of the thigh-bone;

its motions are free and large bearing the trunk above, and rolling upon the thigh-bones below ; and it is so truly the centre of all the great motions of the body, that when we believe the motion to be in the higher parts of the spine, it is either the last vertebra of the loins bending upon the top of the pelvis, or the pelvis itself rolling upon the head of the thigh-bones.

The PELVIS is named partly, perhaps, from its resembling a basin in its form ; or perhaps, from its office of containing the urinary bladder, rectum, vagina, and womb. It consists, in the child, of many pieces ; but in the adult, it is formed of four large bones, of the os sacrum behind, the ossa innominata, one either side, and the os coccygis below.

Os SACRUM. The names os sacrum, os basilare, &c. seem to relate rather to the greater size of this bone, than to its ever having been offered in sacrifice. This bone, with its appendix the os coccygis, is called the false spine, or the column of the false vertebræ ; authors making this distinction, that the true vertebræ are those of the back, neck, and loins, a column which grows gradually smaller upwards ; the false vertebræ are those of the sacrum and coccyx, which are conical with the apex or point downwards, and the base, viz. the top of the sacrum, turned upwards to meet the true spine.

The bones of which the sacrum is composed, have originally the form of distinct small vertebræ. These distinctions are lost in the adult, or are recognized only by the marks of former lines ; for the original vertebræ are now united into one large and firm bone, which is named the column of false vertebræ ; because, having no motion, it wants the chief character and use of the true ones.

We can recognise the original vertebræ even in the adult bone, for we find it regularly perforated with holes for the transmission of the spinal nerves ; we find these holes regularly disposed in pairs ; we see a distinct white and rising line which crosses the bone, in the interstice of each of the original vertebræ, and marks the place where the cartilage once was ; and by these lines being five in number, with five pairs of holes, we know this bone to have consisted once of five pieces, which are now joined into one. The remains of former processes can also be distinguished ; and the back of the bone is rough and irregular from the old spines.

The os sacrum, thus composed, is among the lightest bones of the human body ; with the most spongy substance ; the thinnest tables ; the most easily broken : and its injuries of the most formidable nature : but then it is a bone the best cemented : and confirmed by strong ligaments ; and the best covered by thick and cushion-like muscles. The os sacrum is

of a triangular shape; the base of the triangle turned upwards to receive the spine; its inner surface is smooth, to permit the head of the child in labour to glide easily along; and its outer surface is irregular and rough, with the spines of former vertebræ, giving rise to the great glutæi muscles (which form the contour of the hip,) and to all the strongest muscles of the back and loins.

It has in it a triangular cavity under the arch of its spinous processes; which cavity is continued from the canal in the vertebræ of the spine; and this cavity of the sacrum contains the continuation and the end of the spinal marrow; which being in this place divided into a great many thread-like nerves, has altogether the form of a horse's tail, and is therefore named cauda equina.

From this triangular cavity, the nerves of the cauda equina go out by the five great holes on the forepart of the sacrum; holes large enough to receive the point of the finger. The three first nerves of the sacrum, joining with the last nerve of the loins, form the sacro-sciatic nerve; the largest in the body; which goes downward to the leg; while the two lower nerves of the sacrum supply the contents of the pelvis alone.

The back of the sacrum is also perforated with holes, whose size is nearly equal to those on its forepart, but whose uses are not so distinctly known; for the small nerves which pass outwards by them to the muscles of the loins or hips, are in no degree proportioned to the size of the holes.

All the edges of this triangle form articulating points, by which it is joined to other bones. The base, or upper part of the sacrum, receives the last vertebra of the loins on a large broad surface, which makes a very moveable joint; and indeed, the joining of the last true vertebra, with the top of the sacrum, is a point where there is more motion than in the higher parts of the spine. The apex, or point of the sacrum, has the os coccygis joined to it; and this joining is moveable till the age of twenty in men, and till the age of forty-five in women:—the meaning of its continuing longer moveable in women is very plain, since we distinctly feel the lower point of the coccyx in women, yielding in the time of labour, so as to enlarge greatly the lower opening of the pelvis. The sides of the os sacrum form a broad, rough, and deeply indented surface, which receives the like rough surface of the haunch bones; and here the surfaces are so rough, and the cartilage so thin, that it resembles more nearly a suture; and by the help of the strong ligaments, and of the large muscles which arise in common from either bone, makes a joining absolutely immoveable, except by such violent force as is in the end fatal.

Thus the original state of this bone is easily recognised and traced by many marks; it stands in a conspicuous place of the pelvis, and its chief office is to support the trunk; to which we may add, that it defends the cauda equina; transmits its great nerves; forms chiefly the cavity of the pelvis; and that it is along the hollow of this bone that the accoucheur calculates the progress of the child's head in labour.

The os COCCYGIS, so named from its resemblance to the beak of a cuckow, is a small appendage to the point of the sacrum; terminating this inverted column with an acute point, and found in very different conditions in the several stages of life. In the child it is merely cartilage, and we can find no point of bone; during youth it is ossifying into distinct bones, which continue moveable upon each other till manhood; then the separate bones gradually unite with each other, so as to form one conical bone, with bulgings and marks of the pieces of which it was originally composed; but still the last bone continues to move upon the joint of the sacrum, till in advanced years it is at last firmly united; later in women than in men, with whom it is often fixed at twenty or twenty-five. It is not like the os sacrum, flat, but of a roundish form, convex without and concave inwards; forming with the sacrum the lowest part of the pelvis behind. It has no holes like the sacrum; has no communication with the spinal canal; and transmits no nerves; but points forwards to support the lower parts of the rectum: thus, it contracts the lower opening of the pelvis, so as to support effectually the rectum, bladder, and womb, and yet continues so moveable in women, as to recede in time of labour, allowing the head to pass.

The OSSA INNOMINATA, are the two great irregular bones, forming the sides of the pelvis; and they have a form so difficult to explain by one name, that they are called ossa innominata, the nameless bones. But these bones having been in the child formed in distinct and separate pieces, these pieces retain their original names, though united into one great bone; we continue to explain them as distinct bones by the names of os ilium, os ischium, and os pubis. The os ILIUM, the haunch-bone, is that broad and expanded bone on which lie the strong muscles of the thigh, and which forms the rounding of the haunch. The os ISCHIUM, the hip-bone, is the lowest point of the pelvis, that on which we rest in sitting. The os PUBIS, or share-bone, on which the private parts are placed. All these bones are divided in the child; they are united in the very centre of the socket for the thigh-bone; and we find in the child a thick cartilage in the centre of the socket, and a pro-

minent ridge of bone in the adult; which ridge, far from incommoding the articulation with the thigh-bone, gives a firmer hold to the cartilage which lines that cavity, and is the point into which a strong ligament from the head of the thigh-bone is implanted.

The OS ILIUM, or haunch-bone, is named from its forming the flank. It is the largest part of the os innominatum. It rises upwards from the pelvis in the broad expanded wing, which forms the lower part of the cavity of the abdomen, and supports the chief weight of the impregnated womb (for the womb commonly inclines to one side.) The os ilium is covered with the great muscles that move the thighs, and to its edge are fixed those broad flat muscles which form the walls of the abdomen. This flat upper part is named the ALA, or WING, while the lower, or rounder part, is named the BODY of the bone, where it enters into the socket, and meets the other bones.

The ALA, or flat expanded wing, has many parts, which must be well remembered, to understand the muscles which arise from them. 1. The whole circle of this wing is tipt with a ridge of firmer bone, which encircles the whole. This is a circular cartilage in the child, distinct from the bone, and is ossified and fixed only at riper years. All this ridgy circle is called the spine, and is the origin for the lower oblique and transverse muscles of the abdomen. 2. The two ends of this spine are abrupt, and the points formed upon it are consequently named spinous processes; of which there are two at its fore, and two at its back end. The two POSTERIOR SPINOUS PROCESSES are close by each other, and are merely two rough projecting points near the rough surface, by which the os ilium is joined to the os sacrum; they jut out behind the articulation, to make it firm and sure; and their chief uses seem to be the giving a firm hold to the strong ligaments which bind this joint. 3. The two anterior spinous processes are more distinct and more important marks; for the ANTERIOR SUPERIOR SPINOUS PROCESS is the abrupt ending of the spine or circle of the ilium, with a swelling out; from which jutting point the sartorious muscle, the longest and amongst the most beautiful in the human body, goes obliquely across the thigh, like a strap, down to the knee; another, which is called the tensor vaginæ femoris, also arises here: and from this point departs the ligament, which passing from the os ilium to the pubes, or fore point of the pelvis, is called the ligament of the thigh. How necessary it is to mark this point, may be easily deduced, from knowing that it is under the arch of this femoral ligament that the great artery passes down to the thigh,

and that the femoral hernia is formed. The LOWER ANTERIOR spinous process is a small bump, or little swelling, about an inch under the first one which gives rise to the rectus femoris muscle, or straight muscle of the thigh, which lies along its forepart.

The back, or DORSUM of the os ilium, is covered with the two great glutæi muscles; and the COSTA, as it is absurdly called, or the inner concave surface, gives rise to the internal iliac muscle.

This bone (the os ilium) has a broad rough surface, by which it is connected with the os sacrum at its side; the very form of which declares the nature of this joining, and is sufficient argument and proof that the joinings of the pelvis do not move.

The acute line which is named LINEA INNOMINATA, is seen upon the internal surface of the bone, dividing the ala, or wing, from that part which is in the socket for the thigh. This line composes part of the brim of the pelvis; distinguishes the cavity of the pelvis from the cavity of the abdomen; and marks the circle into which the head of the child descends at the commencement of labour.

The OS ISCHIUM, or hip-bone, is placed perpendicularly under the os ilium, and is the lowest point of the pelvis, upon which we sit. It forms the largest share of the socket; whence the socket is named Acetabulum Ischii, as peculiarly belonging to this bone. The bump or round swelling upon which we rest, is named the Tuber Ischii; and the smaller part which extends upwards to meet the os pubis, is named the Ramus, or branch, which meets a similar branch of that bone, to form the thyroid hole.

The BODY is the uppermost, and thicker part of the bone, which helps in forming the socket; and among the three bones this one forms the largest share of it; nearly one half. From the body, a sharp pointed process, named SPINOUS PROCESS of the ischium, is projected backwards; and this spinous process pointing towards the lower end of the sacrum, receives the uppermost of two long ligaments, which, from their passing betwixt the ischium and sacrum, are named sacro-sciatic. By this ligament a semicircle of the os ilium, just below the joining of the ilium with the sacrum, is completed into a large round hole; which is in like manner named the sacro-sciatic hole, and gives passage to the great nerve of the lower extremity, named the great sacro-sciatic nerve.

The TUBER, or round knob, being the point upon which we rest, this bone has been often named OS SEDENTARIUM. The bump is a little flattened when we sit upon it. It is the mark by which the lithotomist directs his incision; cutting exactly in

the middle betwixt the anus and this point of bone. It is remarkable as the point towards which the posterior or lower sacro-sciatic ligament extends; and as a point which gives rise to several of the strong muscles on the back of the thigh, and especially to those which form the hamstrings.

The RAMUS, or branch, rises obliquely upwards and forwards to join a like branch of the pubes. This branch, or arm as it is called, is flat, and its edges are turned a little forwards and backwards, so that one edge forms the arch of the pubes, while the other edge forms the margin of the thyroid hole.

The OS PUBIS, or SHARE-BONE, is the last and smallest piece of the os innominatum; and is named from the mons veneris being placed upon it, and its hair being a mark of puberty. It forms the upper or forepart of the pelvis, and completes the brim; and, like the ischium, it also is divided into three parts, viz. the BODY, ANGLE, and RAMUS.

The BODY of the pubes is thick and strong, and forms about one-fifth of the socket for the thigh-bone. It is not only the smallest, but the shallowest part of the socket. The bone grows smaller as it advances towards its angle, the joining of the ossa pubis. There it grows again broad and flat, and the two bones meet with rough surfaces, but with two cartilages interposed. Over the middle of this bone, two great muscles, the iliac and psoas muscles, pass out of the pelvis to the thigh; and where they run under the ligament of the thigh, they make the pubes very smooth. Along this bone there is a little edge, or sharp ridge, which markes the brim of the pelvis: and the part which is over the symphisis, or joining of the bones, rising higher than the rest of the ridge, is named the crest of the pubes; and from this point the small pyramidal muscles of the abdomen rise. The RAMUS, or branch, is that more slender part of the pubes, which, joining with the branch of the ischium, forms with it the arch of the pubes, and the edge of the thyroid hole.

This completes the strict anatomy of the pelvis: but when we consider the whole, it is further necessary to repeat, in short definitions, certain points which are oftener mentioned as marks of other parts.

The PROMONTORY of the sacrum is the projection formed by the lowest vertebra of the loins and the upper point of that bone. The HOLLOW of the sacrum is all that smooth inner surface which gives out the great nerves for the legs and pelvis. The LESSER ANGLE, in distinction from the greater angle or

promontory of the sacrum, is a short turn in the bone near where it is joined with the coccyx. The CREST of the PUBES is a sharper ridge or edge of the bone over the joining or symphysis pubis. The POSTERIOR SYMPHYSIS of the pelvis is the joining of the sacrum with the ilium, while the symphysis pubis is distinguished by the name of ANTERIOR SYMPHYSIS of the pelvis. The SPINE, the TUBER, and the RAMUS of the ischium are sufficiently explained. The ALA, or wing, the SPINE, the SPINOUS PROCESSES, and the LINEA INNOMINATA of the ilium, are also sufficiently explained. The ACETABULUM, so named from its resemblance to a measure which the ancients used for vinegar, is the hollow or socket for the thigh-bone, composed of the ilium, ischium and pubes; the ridge in its centre shows the place of its original cartilage, and points out what proportion belongs to each bone; that it is made, two-fifths by the os ilium, two-fifths by the os ischium, and one-fifth only by the os pubis: but the ischium has the greatest share; the ischium forming more than two fifths, and the ilium less. The BRIM of the PELVIS is that oval ring which parts the cavity of the pelvis from the cavity of the abdomen: it is formed by a continued and prominent line along the upper part of the sacrum, the middle of the ilium, and the upper part or crest of the pubes. This circle of the brim supports the impregnated womb; keeps it up against the pressure of the labour pains; and sometimes this line has been "as sharp as a "paper-folder, and has cut across the lower segment of the "womb;" and so, by separating the womb from the vagina, has rendered the delivery impossible; and the child escaping into the abdomen among the intestines, the woman has died. The OUTLET of the PELVIS is the lower circle again, composed by the arch of the pubes, and by the sciatic ligaments, which is wide and dilatable, to permit the delivery of the child; but which, being sometimes too wide, permits the child's head to press so suddenly, and with such violence, upon the soft parts, that the perineum is torn. The THYROID HOLE is that remarkable vacancy in the bone which perhaps lightens the pelvis, or perhaps allows the soft parts to escape from the pressure during the passage of the head of the child.

The marks of the female skeleton have been sought for in the skull, as in the continuation of the sagittal suture; but the truest marks are those which relate to that great function by which chiefly the sexes are distinguished: for while the male pelvis is large and strong, with a small cavity, narrow openings, and bones of greater strength; the female pelvis is very shallow and wide, with a large cavity and slender bones, and with every peculiarity which may conduce to the easy passage of the

child. And this occasions that peculiar form of the body which the painter is at greater pains to mark, and which is indeed very easily perceived: for the characteristic of the manly form is firmness and strength; the shoulders broad, the haunches small, the thighs in a direct line with the body, which gives a firm and graceful step. The female form again is delicate, soft and bending; the shoulders are narrow; the haunches broad; the thighs round and large; the knees, of course, approach each other, and the step is unsure; the woman, even of the most beautiful form, walks with a delicacy and feebleness, which we come to acknowledge as a beauty in the weaker sex.

The bones of the pelvis compose a cavity which cannot be fairly understood in separate pieces, but which should be explained as a whole. Though perhaps its chief office is to support the spine, still its relation to labour deserves to be observed; for this forms at least a curious inquiry, though it should not be allowed a higher place in the order of useful studies.

We know, from much experience, that where the pelvis is of the true size, we have an easy and natural labour: that where the pelvis is too large, there is pain and delay; but not that kind of difficulty which endangers life: that where, by distortion, the pelvis is reduced below the standard size, there comes such difficulty as endangers the mother, and destroys the child, and renders the art of midwifery still worthy of serious study, and an object of public care.

There was a time when it was universally believed, that the joinings of the pelvis dissolved in every labour; that the bones parted, and the openings were enlarged; that the child passed with greater ease; and "that this opening of the basin was "no less natural than the opening of the womb." By many accidents, this opinion has been often strengthened and revived; and if authority could determine our opinion, we should acknowledge, that the joinings of the pelvis were always dissolved, as a wise provision of nature for facilitating natural, and preventing lingering, labour, compensating for the frequent deviations, both in the head and pelvis, from their true and natural size. This unlucky opinion has introduced, at one time, a practice the most reprehensibly simple; as fomentations to soften these joinings of the pelvis in circumstances which require very speedy help; while, at another time, it has been the apology for the most cruel, unnatural operations of instruments, not merely intended for dilating and opening the soft parts, but for bursting up these joinings of the bones. And those also, of late years, who have invented and per-

formed (too often, no doubt) this operation of cutting the symphysis pubis to hasten the labour, say, that they do not perform an unnecessary cruel operation, but merely imitate a common process of nature.

How very far nature is from intending this, may be easily known from the very forms of these joinings, but much more from the other offices which these bones have to perform; for if the pelvis be, as I have defined it, an arch standing betwixt the trunk and the lower extremities, on which the body rolls, its joinings could not part without pain and lameness, perhaps inability for life.

One chief reason drawn from anatomy is this: that in women dying after labour, the gristles of the pelvis are manifestly softened; the bones loosen; and though they cannot be pulled asunder, they can be shuffled or moved upon each other in a slight degree: all which is easily accounted for. The gristle that forms the symphysis pubis is not one gristle only, as was once supposed, but a peculiar gristle covers the end of each bone, and these are joined by a membranous or ligamentous substance: this ligamentous substance is the part which corrupts the soonest; it is often spoiled, and in the place of it a hollow only is found; that hollow of the corrupted ligament may be called a separation of the bones; but it is such a separation as "equals only the back of a common knife in breadth, "and will not allow the bones to depart from each other;" the joining is still strong, for it is surrounded by a capsular ligament, not like the loose ligament of a moveable joint, but adhering to every point of each bone: and this ligament does perform its office so completely, that while it remains entire, though the bones shuffle sidewise upon each other, no force can pull them asunder: "Even when the fore part of the pelvis "is cut out, and turned and twisted betwixt the hands, still, "though the bones can be bent backwards and forwards, they "cannot be pulled from each other the tenth part of an inch." These inquiries were made by one, who, though partial to the other side of this question, could not allow himself to disguise the truth, whose authority is the highest, and by whose facts I should most willingly abide.

Now, it is plain, that since a separation, amounting only to the 12th of an inch, occasions death, this cannot be a provision of nature; and since the separation in such degree could not enlarge the openings of the basin, there again it cannot be a provision of nature. I know that tales are not wanting of women whose bones were separated during labour; but what is there so absurd, that we shall not find a precedent or parallel case in our annals of monstrous and incredible facts? Or

rather, where is there a fact of this description which is not balanced and opposed by opposite authorities and facts? I have dissected several women who had died in lingering labour, where I found no disunion of the bones. I have seen women opened, after the greatest violence with instruments, and yet found no separation of the bones. We have cases of women having the mollities ossium, a universal softness and bending of the bones, who have lived in this condition for many years, with the pelvis also affected; its openings gradually more and more abridged; the miserable woman suffering lingering labour, and undergoing the delivery by hooks, with all the violence that must be used in such desperate cases, and still no separation of the bones happening. How, indeed, should there be such difficult labours as these, if the separation of the bones could allow the child to pass?

If it be said, "the joinings of the pelvis are sometimes dis "solved," I acknowledge that they are, just as the joint of the thigh is dissolved; that is, sometimes by violence, and sometimes by internal disease; but if it be affirmed, that "the joinings of the pelvis are dissolved to facilitate labour," I would observe, that wherever separation of the bones has happened, it has both increased the difficulties of the labour, and been in itself a very terrible disease; for proofs of which, I must refer to Hunter, Denman, and others, to whose peculiar province such cases belong. But surely these principles will be universally acknowledged: that the pelvis supporting the trunk is the centre of its largest motions: that if the bones of the pelvis were loosened, such motions could no longer be performed: that when, by violence or by internal disease, or in the time of severe labour, these joinings have actually been dissolved or burst, the woman has become instantly lame, unable to sit, stand, or lie, or support herself in any degree; she is rendered incapable of turning, or even of being turned in bed; her attendants cannot even move her legs, without intolerable anguish, as if torn asunder.* There sometimes follows a collection of matter within the joint (the matter extending quite down to the tuber ischii,) high fever, delirium, and death;† or in case of recovery (which is indeed more frequent,) the recovery is slow and partial only; a degree of lameness remains, with pain, weakness, and languid health; they can stand on one leg more easily than on both; they can walk more easily than they can stand; but it is many months before they can walk without crutches; and long after they

* Denman. † Hunter.

come to walk upon even ground, climbing a stair continues to be very difficult and painful. In order to obtain even this slow re-union of the bones, the pelvis must be bound up with a circular bandage very tight; and they must submit to be confined long: by neglect of which precautions, sometimes, by the rubbing of the bones, a preternatural joint is formed, and they continue lame for years, or for life;* or sometimes the bones are united by ossification; the callus or new bone projects towards the centre of the pelvis, and makes it impossible for the woman to be delivered again of a living child.†

Now this history of the disease leads to reasons independent of anatomy, and surer than it; which prove, that this separation of the bones (an accident the existence of which cannot be questioned) is not a provision of nature, but a most serious disease. For if these be the dreadful consequences of separation of the bones, how can we believe that it happens, when we see women walking during all their labour, and, in place of being pained, rather relieved by a variety of postures, and by walking about their room? when we see them often walk to bed after being delivered on chairs or couches? rise up on the third day; and often resume the care and fatigues of a family in a few days more? or can we believe, that there is a tendency to separation of the bones in those who, following the camp, are delivered on one day, and walk on the following? or in those women who, to conceal their shame, have not indulged in bed a single hour? or can we believe, that there is even the slightest tendency to the separation of the bones in those women whose pelvis resists the force of a lingering and severe labour; who suffer still further all the violence of instruments; who yet recover as from a natural delivery, and who also rise from bed on the third or fourth day?

* Denman says twenty-five or thirty years.
† Spence's cases.

CHAP. VI.

BONES OF THE THIGH, LEG, AND FOOT.

THE THIGH-BONE is the greatest bone of the body, and needs to be so, supporting alone, and in the most unfavourable direction, the whole weight of the trunk; for though the body of this bone is in a line with the trunk, in the axis of the body, its neck stands off almost at right angles with the body of the bone; and in this unfavourable direction must it carry the whole weight of the trunk; for the body is seldom so placed as to rest its weight equally upon either thigh-bone; commonly it is so inclined from side to side alternately, that the neck of one thigh-bone bears alone the whole weight of the body and limbs, or is still loaded with greater burdens than the mere weight of the body itself.

The thigh-bone is one of the most regular of the cylindrical bones. 1. Its BODY is very thick and strong; of a rounded form; swelling out at either end into two heads. In its middle it bends a little outwards, with its circle or convex side turned towards the forepart of the thigh. This bending of the thigh-bone has been a subject of speculation abundantly ridiculous, viz. whether this be an accidental or a natural arch. There are authors who have ascribed it to the nurse carrying the child by the thighs, and its soft bones bending under the weight. There is another author, very justly celebrated, who imputes it to the weight of the body and the stronger action of the flexor muscles; affirming, that it is straight in the child, and grows convex by age. This could not be, else we should find this curve less in some, and greatest in those who had walked most, or whose muscles had the greatest strength; and if the muscles did produce this curve, a little accident giving the balance to the flexor muscles should put the thigh-bone in their power to bend it in any degree, and to cause distortion. But the end of all such speculations is this, that we find it bended in the fœtus not yet delivered from the mother's womb, or in a chicken while still enclosed in the shell; it is a uniform and regular bending, designed and marked in the very first formation of the bone, and intended, perhaps, for the advantage of the strong muscles in the back of the thigh, to give them greater power, or more room.

2. The HEAD of the thigh-bone is likewise the most perfect of any in the human body; for its circumference is a very re-

gular circle, of which the head contains nearly two-thirds : it is small, neat, and completely received into its socket, which is not only deep itself, and very secure, but is further deepened by the cartilage which borders it ; so that this is naturally, and without the help of ligaments, the strongest joint in all the body ; but among other securities which are superadded, is the round ligament, the mark of which is easily seen, being a broad dimple in the centre of its head.

3. The NECK of this bone is the truest in the skeleton ; and indeed it is from this neck of the thigh-bone that we transfer the name to other bones, which have hardly any other mark of neck than that which is made by their purse-like ligament being fixed behind the head of the bone, and leaving a roughness there. But the neck of the thigh-bone is an inch and a half in length, thick and strong, yet hardly proportioned to the great weights which it has to bear ; long, that it may allow the head to be set deeper in its socket ; and standing wide up from the shoulder of the bone, to keep its motions wide and free, and unembarrassed by the pelvis ; for without this great length of the neck, its motions had been checked even by the edges of its own socket.

The TROCHANTER are the longest processes in the human body for the attachment of muscles, and they are named trochanter (or processes for turning the thigh) from their office, which is the receiving of those great muscles which not only bend and extend the thigh, but turn it upon its axis ; for these processes are oblique, so as to bend and turn the thigh at once.

4. The TROCHANTER MAJOR, the outermost and longer of the two, is that great bump which represents the direct end of the thigh-bone, while the neck stands off from it at one side ; therefore the great trochanter stands above the neck, and is easily distinguished outwardly, being that great bump which we feel so plainly in laying the hand upon the haunch. This process receives the glutæi muscles, and all the great muscles which move the thigh outwards.

5. The TROCHANTER MINOR, or lesser trochanter, is smaller and more pointed ; rising on the inner side of the bone ; lower than the trochanter major, and placed under the root of the neck, as the greater one is placed above it. It is deeper in the thigh, and never to be felt, not even in luxations. Its muscles also, by the obliquity of their insertion into it, turn the thigh, and bend it towards the body ; such as the psoas and iliacus internus, which passing out from the pelvis, sink deep into the groin, and are implanted into this point. From the one trochanter to the other, there is a very conspicuous roughness,

which marks the place of the capsule or ligamentary bag of the joint; for it encloses the whole length of the neck and of the thigh-bone. This roughness begins the great rough line, and is what is regularly named the linea aspera.

6. The LINEA ASPERA is a rising or prominent line, very ragged and unequal, which runs all down the back part of the thigh: it begins at the roots of the two trochanters, and the rough lines from each trochanter meet about four inches down the bone; thence the linea aspera runs down the back of the bone a single line, and forks again into two lines, one going towards each condyle, and ending in the tubercles at the lower end of the bone; so that the linea aspera is single in the middle, and forked at either end.

7. The CONDYLES are the two tubers into which the thigh-bone swells out at its lower part. There is first a gentle and gradual swelling of the bone; then an enlargement into two broad and flat surfaces, which are to unite with the next bone in forming the great joint of the knee. The two tuberosities, which, by their flat faces, form the joint, swell out above the joint, and are called the CONDYLES. The INNER CONDYLE is larger, to compensate for the oblique position of the thigh-bone; for the bones are separated at their heads by the whole width of the pelvis, but are drawn towards a point below, so as to touch each other at the knees. On the fore part of the bone, betwixt the condyles, there is a broad, smooth surface, upon which the rotula, or pulley-like bone glides; and on the back part of the thigh-bone, in the middle betwixt the condyles, there is a deep notch, which contains the great artery, vein, and nerve of the leg.

The great nutritious artery enters below the middle of this bone, and smaller arteries enter through its porous extremities: as may be known by many small holes near the head of the bone.

The HEAD of the thigh-bone is round, and set down deeply in its socket, to give greater security to a joint so important, and so much exposed as the hip is. The NECK stands off from the rest of the bone, so that by its length, it allows a free play to the joint, but is itself much exposed by its transverse position, as if nature had not formed in the human body any joint at once free, moving and strong. The neck is not formed in the boy, because the socket is not yet deep, nor such as to hinder the motions of the thigh; and the head is formed apart from the bone, and is not firmly united with it till adult years, so that falls luxate or separate the head in young people, but they break the neck of the bone in those that are advanced in years. The TROCHANTERS, or shoulders, are large to receive

the great muscles which are implanted in them, and oblique, that they may at once bend and turn the thigh. The SHAFT or BODY is very strong, that it may bear our whole weight, and the action of such powerful muscles; and it is marked with the rough line behind, from which a mass of flesh takes its rise, which wraps completely round the lower part of the thigh-bone, and forms what are called the vasti muscles, the greatest muscles for extending the leg. The CONDYLES swell out to give a broad surface, and a firm joining for the knee. But of all its parts, the great trochanter should be most particularly observed, as it is the chief mark in luxations or fractures of this bone: for when the greater trochanter is pushed downwards, we find the thigh luxated downwards; when the trochanter is higher than its true place, and so fixed that it cannot roll, we are assured that it is luxated upwards; but when the trochanter is higher than its true place, with the thigh rolling freely, we are assured its neck is broken, the trochanter being displaced, and the broken head remaining in its socket; but when the trochanter remains in its place, we should conclude that the joint is but little injured, or that it is only a bruise of those glands or mucous follicles which are lodged within the socket for lubricating the joint.

The TIBIA is named from its resemblance to a pipe; the upper part of the tibia, representing the expanded or trumpet-like end, the lower part representing the flute end of the pipe. The tibia, on its upper end, is flat and broad, making a most singular articulation with the thigh-bone; for it is not a ball and socket like the shoulder or hip, nor a hinge joint guarded on either side with projecting points like the ankle. There is no security for the knee joint by the form of its bones, for they have plain flat heads: they are broad indeed, but they are merely laid upon each other. It is only by its ligaments that this joint is strong; and by the number of its ligaments it is a complex and delicate joint, peculiarly liable to disease.

1. The UPPER HEAD of the tibia is thick and spongy, and we find there two broad and superficial hollows, as if impressed while soft, with the marks of the condyles of the thigh-bone; and these slight hollows are all the cavity that it has for receiving the thigh-bone. A pretty high ridge rises betwixt these two hollows, so as to be received into the interstice betwixt the condyles; and at the back part, which is the highest point of the ridge, an internal ligament ties the tibia to the thigh-bone. This spongy head has also a rough margin, to which the capsular ligament is tied; on the fore part of this bone, just below the knee, there is a bump for receiving the

great ligament of the patella, or, in other words, the great tendon of all the extensor muscles of the leg; and lastly, there is upon the outer side of this spongy head, just under the margin of the joint, a smooth articulating surface, (like a dimple impressed with the finger,) for receiving the head of the fibula. It is under the margin of the joint, for the fibula does not enter at all into the knee joint; it is only laid upon the side of the tibia, fixed to it by ligaments, but not received into any thing like a cavity.

2. The BODY of the bone is of a prismatic or triangular form, and its three edges or acute angles are very high lines running along its whole length; one line a little waved, and turned directly forwards, is what is called the shin. At the top of this ridge is that bump into which the ligament of the rotula or patella is implanted; and the whole length of this acute line is so easily traced through the skin, that we can never be mistaken about fractures of this bone. Another line less acute than this is turned directly backwards; and the third acute line, which completes the triangular form, is turned towards the fibula, to receive a broad ligament, or interosseous membrane, which ties the two bones together.

3. The lower head of the tibia composes the chief parts of the ankle-joint. The lower head of the tibia is smaller than the upper, in the same proportion that the ankle is smaller than the knee. The pointed part of this head of the tibia represents the mouth-piece, or flute part of the pipe, and constitutes the bump of the INNER ANKLE. The lower end of the fibula lies so upon the lower end of the tibia, as to form the outer ankle; and there is on the side of the tibia a deep hollow, like an impression made with the point of the thumb, which receives the lower end of the fibula. The acute point of the tibia, named the process of the inner ankle, passes beyond the bone of the foot, and by lying upon the side of the joint, guards the ankle, so that it cannot be luxated outwards, without this pointed process of the maleolus internus, or inner ankle, being broken.

The tibia is a bone of great size, and needs to be so, for it supports the whole weight of the body. It is not at all assisted by the fibula in bearing the weight, the fibula, or slender bone, being merely laid upon the side of the tibia, for uses which shall be explained presently. The tibia is thick, with much cancelli or spongy substance within; has pretty firm plates without; is much strengthened by its ridges, and by its triangular form: its ridges are regular with regard to each other, but the whole bone is twisted as if it had been turned betwixt the hands when soft: this distortion makes the process of the inner ankle lie not regularly upon the side of that joint, but

a little obliquely forwards, determining the obliquity of the foot; which must be of much consequence, since there are many provisions for securing this turning of the foot, viz. the oblique position of the trochanters; the oblique insertion of all the muscles, and this obliquity of the ankles; the inner ankle advancing a little before the joint, and the outer ankle receding in the same degree behind it.

The FIBULA, which is named so from its resemblance to the Roman clasp, is a long, slender bone, which is useful partly in strengthening the leg, but chiefly in forming the ankle joint; for the tibia only is connected with the knee, while the fibula, which has no place in the knee joint, goes down below the lower end of the tibia, forming the long process of the outer ankle.

The fibula is a long and slender bone, the longest and slenderest in the body. It lies by the side of the tibia like a splint; so that when at any time the tibia is broken without the fibula, or when the tibia having spoiled, becomes carious, and a piece of it is lost, the fibula maintains the form of the limb till the last piece be replaced, or till the fracture be firmly reunited. It is, like the tibia, triangular, and has two heads, which are knots, very large, and disproportioned to so slender a bone. The sharpest line of the fibula is turned to one sharp line of the tibia, and the interosseous membrane passes betwixt them. The bone lies in a line with the tibia, on the outer side of it, and a little behind it. The upper head of the fibula is laid upon a plain, smooth surface, on the side of the tibia, a little below the knee; and though the fibula is not received deep into the tibia, this want is compensated for by the strong ligaments by which this little joint is tied by the knee, being completely wrapped round with the expanded tendons of those great muscles which make up the thigh, by the knee being still farther embraced closely by the fascia, or tendinous expansion of the thigh; but above all, by the tendons of the outer hamstrings being fixed into this knot of the fibula, and expanding from that over the fore part of the tibia.

The lower head of the fibula is let pretty deep into a socket on the side of the tibia; together, they form the ankle joint for receiving the bones of the foot. The ankle joint is one of the purest hinge joints, and is very secure; for there is the tibia, at the process of the inner ankle, guarding the joint within; there is the fibula passing the joint still further, and making the outer ankle still a stronger guard without. These two points, projecting so as to enclose the bones of the foot, make a pure hinge; prevent all lateral motion; make the joint firm and strong; and will not allow of luxations till one

or both ankles be broken. We know that there is little motion betwixt the tibia and fibula; none that is sensible outwardly, and no more in truth than just to give a sort of elasticity, yielding to slighter strains. But we are well assured, that this motion, though slightest and imperceptible, is very constant; for these jointings of the fibula with the tibia are always found smooth and lubricated; and there are no two bones in the body so closely connected as the tibia and fibula are, which are so seldom anchylosed, *i. e.* joined into one by disease.

The fibula may be thus defined: it is a long slender bone, which answers to the double bone of the fore arm, completes the form, and adds somewhat to the strength of the leg: it gives a broader origin for its strong muscles; lies by the side of the tibia like a splint; and, being a little arched towards the tibia, supports it against those accidents which would break it across, and maintains the form of the leg when the tibia is carious or broken; the fibula, though it has little connection with the knee, passes beyond the ankle joint, and is its chief guard and strength in that direction in which the joint should be most apt to yield; and in this office of guarding the ankle, it is so true, that the ankle cannot yield till this guard of the fibula be broken.

ROTULA or PATELLA, or KNEE-PAN, is a small thick bone, of an oval, or rather triangular form. The basis of this rounded triangle is turned upwards to receive the four great muscles which extend the leg, the pointed part of this triangle is turned downwards, and is tied by a very strong ligament to the bump or tubercle of the tibia, just under the knee. This ligament is called the ligament of the patella, or of the tibia, connecting the patella so closely, that some anatomists of the first name choose to speak of the patella as a mere process of the tibia, (as the olecranon is a process of the ulna), only flexible and loose; an arrangement which I think so far right and useful, as the fractures of the olecranon and of the patella are so much alike, especially in the method of cure, that they may be spoken of as one case; for these two are the only exceptions to the common rules and methods of setting broken bones.

The patella is manifestly useful, chiefly as a lever; for it is a pully, which is a species of lever, gliding upon the forepart of the thigh-bone upon the smooth surface which is betwixt the condyles. The projection of this bone upon the knee removes the acting force from the centre of motion, so as to increase the power; and it is beautifully contrived, that while the knee is bent, and the muscles at rest, as in sitting, the patella sinks down concealed into a hollow of the knee. When the muscles begin to act, the patella begins to rise from this hollow: it

proportion as they contract, they lose their strength, but the patella gradually rising, increases the power; and when the contraction is nearly perfect, the patella has risen to the summit of the knee, so that the rising of the patella raises the mechanical power of the joint in exact proportion as the contraction expands the living contractible power of the muscles. What is curious beyond almost any other fact concerning the fractures of bones, the patella is seldom broken by a fall or blow; in nine of ten cases, it is rather torn, if we may use the expression, by the force of its own muscles, while it stands upon the top of the knee, so as to rest upon one single point; for while the knee is half-bended, and the patella in this dangerous situation, the leg fixed, and the muscles contracting strongly to support the weight of the body, or to raise it as in mounting the steps of a stair, the force of the muscles is equivalent at least to the weight of the man's body; and often, by a sudden violent exertion, their power is so much increased, that they snap the patella across, as we would break a stick across the knee.

The TARSUS, or INSTEP, is composed of seven large bones, which form a firm and elastic arch for supporting the body; which arch has its strength from the strong ligaments with which these bones are joined, and its elasticity from the small movements of these bones with each other; for each bone and each joint has its cartilage, its capsule or bag, its lubricating fluid, and all the apparatus of a regular joint; each moves, since the cartilages are always lubricated, and the bones are never joined by anchylosis with each other; but the effect is rather a diffused elasticity, than a marked and perceptible motion in any one joint.

The seven bones of which the tarsus is composed are, 1. The ASTRAGALUS, which, united with the tibia and fibula, forms the ankle joint: 2. The os CALCIS, or heel bone, which forms the end or back point of that arch upon which the body stands: 3. The os NAVICULARE, or boat-like bone, which joins three smaller bones of the forepart of the tarsus to the astragalus: 4. The os CUBOIDES, which joins the smaller bones of the forepart to the os calcis: The 5th, 6th, and 7th, are the smaller bones making the forepart of the tarsus; they lie immediately under the place of the shoe-buckle, and are named the three CUNEIFORM BONES, from their wedge-like shape; and it is upon these that the metatarsal bones, forming the next division of the foot are implanted.

These bones of the tarsus form, along with the next rank or metatarsal bones, a double arch; first from the lowest point of the heel to the ball of the great toe, is one arch; the arch of

the sole of the foot which supports the body: and again, there is another arch within this, formed among the tarsal bones themselves, one within another, *i. e.* betwixt the astragalus, calcis, and naviculare; through which hole, in my drawing, there is passed a pencil. It is this second arch which gives a perfect elasticity to the foot, and must prevent the bad effects of leaping, falls, and other shocks, which would have broken a part less curiously adapted to its office.

1. The ASTRAGALUS is the greatest and most remarkable bone of the tarsus; and which the surgeon is most concerned in knowing. The semicircular head of this bone forms a curious and perfect pulley. The circle of this pulley is large; its cartilage is smooth and lubricated; it is received deep betwixt the tibia and fibula; and rolls under the smooth articular surface of the latter, which being suited to this pulley of the astragalus, with something of a boat-like shape, is often named the scaphoid cavity of the tibia. 1. We remark in the astragalus its articulating surface, which is arched, high, smooth, covered with cartilage, lubricated, and in all respects a complete joint. Its form is that of a pulley, which, of course, admits of but one direct motion, viz. forwards and backwards. 2. We observe its sides, which are plain, smooth, and flat, covered with the same cartilage, forming a part of the joint, and closely locked in by the inner and outer ankles, so as to prevent luxations or awkward motions to either side. 3. We observe two large irregular articulating surfaces backwards, by which it is joined to the os calcis. 4. There is on the fore-part, or rather the fore end of the astragalus, a large round head, as regular as the head of the shoulder bone, by which it is articulated with the scaphoid bone.

2. The os CALCIS is the large irregular bone of the heel; it is the tip or end of the arch formed by the tarsal and metatarsal bones. There is a large scabrous point on which we stand; which is rough, for the insertion of the great Achillis tendon, the rope by which the muscles of the bran act. The roughness of the heel-bone gives the tendon a firm hold, and its projection backwards gives it the power of a very long lever. The points to be observed are, 1. The great backward projection, which is properly called the heel; scabrous and rough, for the insertion of the great back tendon; the point upon which we walk and stand. 2. An irregular articular surface, or rather two surfaces covered with cartilage, by which it is joined with the astragalus. 3. Another articulating surface by which it is joined with the os cuboides. And, 4. A sort of arch downwards, under which the vessels and nerves and the tendons also pass on safely into the sole of the foot.

3. NAVICULARE is named OS NAVICULARE, or OS SCAPHOIDES, from a fanciful resemblance to a boat. But this is a name of which anatomists have been peculiarly fond, and which they have used with very little discretion or reserve; the student will hardly find any such resemblance; it is rather like the dies with which we play at drafts; that is, a flattened circular body, with its borders rising up a little; and each flat side forms an articulating surface. That concave side which looks backwards, is pretty deep, and receives the head of the astragalus: that flat side which looks forwards, has not so deep a socket, but receives the three cuneiform bones upon a surface rather plain and irregular.

The CUNEIFORM BONES are so named, because they resemble wedges, being laid to each other like the stones of an arch. The most simple and proper arrangement is, 1. 2. and 3.; counting from the side of the great toe towards the middle of the foot; but they are commonly named thus: the first cuneiform bone on which the great toe stands, has its cutting edge turned upwards; is much larger than the others, and so is called OS CUNEIFORME MAGNUM. The second cuneiform bone, or that which stands the middle of the three cuneiform bones, is much smaller, and is therefore named OS CUNEIFORME MINIMUM. The third in order of the cuneiform bones is named OS CUNEIFORME MEDIUM*: These cuneiform bones receive the great toe, and the two next to it. The fourth and fifth toes are implanted upon the last bone in the row, the os cuboides.

OS CUBOIDES.—The os cuboides is named from its cubical figure; and is next to the astragalus in size; greater than the scaphoid bone. The three cuneiform bones are laid regularly by the side of each other; and this os cuboides is again laid on the outer side of the third cuneiform bone, and joins it to the os calcis. The place and effect of the cuboid bone is very curious; for as it is wedged in betwixt the third cuneiform bone and the os calcis, it forms a complete arch within an arch, which gives at once a degree of elasticity and of strength which no human contrivance could have equalled. There is first a great arch on which the body rests, and the heel and the

* The confusion in these names arises from sometimes counting them by their place, and sometimes reckoning according to their size. It is only in relation to its size that we call one of these bones os cuneiforme medium; for the os cuneiforme medium is not in the middle of the three; it is the middle bone with respect to size; it is the smallest of the cuneiform bones that stands in the middle betwixt the other two.

great toe are the horns of that bow: and, secondly, there is a complete circle among the metatarsal bones, leaving an opening betwixt the astragalus and the os calcis.

THE TOES.—The last division of the foot consists of three distinct bones; and as these bones are disposed in rows, they are named the first, second and third phalanges or ranks of the toes.

The great toe has but two phalanges; the other toes have three ranks of bones, which have nothing particular, only the joints are round and free; formed by a round head on one bone, and by a pretty deep hollow for receiving it, in the one above it; they are a little flattened on their lower side, or rather they have a flattened groove which lodges the tendons of the last joint of the toes.

The SESAMOID BONES are more regularly found about the toes than any where else. They are small bones, like peas, found in the hearts of tendons, at any point where they suffer much friction; or rather they are like the seeds of the sesamum, whence their name. They are found chiefly at the roots of the great toe, and of the thumb; at each of these places we find two small sesamoid bones, one on each side of the ball of the great toe, and one on each side of the ball of the thumb; but these bones do not enter into the joint; they are within the substance of the tendons; perhaps, like the patella, they remove the acting force from the centre of motion; and so, by acting like pulleys, increase the power; perhaps also by lying at the sides of the joint in the tendons of the shorter muscles of the toes, they make a safe gutter for the long tendons to pass in. They are not restricted to the balls of the great toe and thumb, but sometimes are also found under the other toes and fingers, and sometimes behind the condyles of the knee; or in the peronæi tendons, which run under the sole of the foot. In short, they are so far from being regular bones, that they are found only in adults, and are so often found in irregular places, that they almost seem to be produced by chance, or by the effect of friction.

METATARSUS.—The metatarsus, so named from its being placed upon the tarsus, consists of five bones, which differ so little from the first bones of the fingers, that they need not be minutely demonstrated. It is sufficient to mark, that they are five in number, having a general resemblance to the joints of the finger; that they are rather flattened, especially on their lower sides, where the tendons of the toes lie; that they are very large at their ends next the tarsus, where they have broad flat heads, that they may be implanted with great security; that

they grow smaller towards the toes, where again they terminate in neat, small, round heads, which receive the first bones of the toes, and permit of a very free and easy motion, and a greater degree of rotation than our dress allows us to avail ourselves of; the toes being cramped together, in a degree that fixes them all in their places, huddles one above another, and is quite the reverse of that free and strong-like spreading of the toes, which the painter always represents. Lastly, it should be remarked, that the metatarsal bone of the little toe makes a salient angle, projecting over the tarsus, in a point which is easily felt outwardly, at the place where the side seam of the shoe crosses: for this and all the other marks of the metatarsal bones are chiefly useful, as directing us where to cut in amputating these bones; and the surgeon will save the patient much pain, and himself the shame of a slow and confused operation, by marking the places of the joints.

CHAP. VII.

BONES OF THE SHOULDER, ARM AND HAND.

OF THE SCAPULA, OR SHOULDER-BLADE.

This is the great peculiarity of the superior extremity, that it is connected not directly with the trunk, like the thigh-bone with the haunch, but is hung by a moveable intermediate bone; which not only is not immediately joined to the trunk by ligaments, or any other form of connection, but is parted from it by several layers of muscular flesh, so that it lies flat, and glides upon the trunk.

The SCAPULA is a thin bone; which has originally, like the skull, two tables, and an intermediate diploë; but by pressure, and the action of its own muscles, it grows gradually thinner; its tables are more and more condensed; till in old age it has become perfectly transparent, and is supported only by its processes, and by its thicker edges. For its SPINE is a ridge of firm and strong bone, which rises very high, and gives a broad origin and support for its muscles: the ACROMION in which the spine terminates, is a broad and flat process, a sure guard for

the joint of the shoulder: the CORACOID process is a strong but shorter process, which stands out from the neck of the bone; and the COSTA, or borders of the bone are also rounded, firm and strong: so that the processes and borders support the flat part of the bone, which is as thin as a sheet of paper, and quite transparent.

There is no part nor process of the scapula which does not require to be very carefully marked; for no accidents are more frequent than luxations of the shoulder; and the various luxations are explained best by studying in the skeleton, and being able to recognize on the living body all the processes and projecting points.

1. The FLAT SIDE of the scapula is smooth, somewhat concave, and suited to the convexity of the ribs. The scapula connected with no bone of the trunk; tied by no ligaments; is merely laid upon the chest, with a large mass of muscular flesh under it, upon which it glides; for there are below it two layers of muscles, by one of which the shoulder bone is moved upon the scapula, while by the other the scapula itself is moved upon the ribs. The muscle lying in the hollow of the scapula marks it with many smooth hollows and wave-like risings, which are merely the marks of the origin of its muscles, but which were mistaken even by the great Vesalius for the impressions of the ribs.

2. The outer flat surface is like the inner one, but that it is traversed by the SPINE, which is a very acute and high ridge of bone. Now the spine, thus traversing the bone from behind forwards, divides its outer surface into two unequal parts, of which the part above the spine is smaller, and that below the spine larger. Each of these spaces has its name, one supra spinatus, and the other infra spinatus; and each of them lodges a muscle, named, the one the musculus supra-spinatus scapulæ, as being above the spine; the other, musculus infra-spinatus scapulæ, as being below the spine. A third muscle is named sub-scapularis, as lying under the shoulder-blade, upon that concave surface which is towards the ribs; so that the whole scapula is covered with broad flat muscles, whose offices are to move the shoulder-bone in various directions, and which impress the scapula with gentle risings and hollows on its outer as well as on its inner surface.

3. The TRIANGULAR form of the scapula must be next observed. The upper line of the triangle is the shortest; it is named the COSTA or border. This superior costa of the scapula receives those strong and flat muscles that raise the shoulder upwards. The lower border, which is named the COSTA INFERIOR, or the lower border of the scapula, receives

no muscles, because it must be quite free, to move and glide as the scapula turns upon its axis, which is indeed its ordinary movement. But it gives rise to two smaller muscles, which, from being a little rounded, are named the musculi teres; which round muscles being implanted into the arm bone, pull it downwards.

The long side of the scapula, which bounds its triangular form backwards, is named the BASIS of the SCAPULA, as it represents the base of the triangle. This line is also like the two borders, a little thicker, or swelled out; and this edge receives many powerful muscles, which lie flat upon the back, and coming to the scapula in a variety of directions, can turn it upon its axis, sometimes raising, sometimes depressing the scapula; sometimes drawing it backwards; and sometimes fixing it in its place, according to the various sets of fibres which are put into action.

4. The GLENOID, or ARTICULATING CAVITY of the scapula, is on the point or apex of this triangle. The scapula is more strictly triangular in a child, for it terminates almost in a point or apex; and this articulating surface is a separate ossification, and is joined to it in the adult. The scapula, towards this point terminates in a flat surface, not more than an inch in diameter, very little hollowed, and scarcely receiving the head of the shoulder bone, which is rather laid upon it than sunk into it; it is indeed deepened a little by a circular gristle, which tips the edges or lips of this articulating surface, but so little, that it is still very shallow and plain, and luxations of the shoulder are infinitely more frequent than of any other bone.

5. This head, or glenoid cavity of the scapula, is planted upon a narrower part, which tends towards a point, but is finished by this flat head; this narrower part is what is named the NECK of the SCAPULA, which no doubt sometimes gives way, and breaks. A rough line bordering the glenoid cavity receives the capsular ligament, or rather the capsule arises from that bordering gristle, which I have said tips the circle.

6. The SPINE of the SCAPULA is that high ridge of bone, which runs the whole length of its upper surface, and divides it into two spaces for the origin of supra and infra spinatus muscles. It is high, and very sharp, standing up at one place to the height of two inches. It is flattened upon the top, and with edges, which turning a little towards either side, give rise to two strong fasciæ, *i. e.* tendinous membranes; which go from the spine, the one upwards to the upper border of the scapula, the other downwards to the lower border; so that by these strong membranes the scapula is formed into two trian-

gular cavities, and the supra and infra spinatus muscles rise not only from the back of the scapula, and from the sides of its spine, but also from the inner surface of this tense membrane. The spine traverses the whole dorsum, or back of the scapula; it receives the trapezius muscle, that beautiful triangular muscle which covers the neck like a tippet, whence it has its name; and the spine beginning low at the basis of the scapula, gradually rises as it advances forwards, till it terminates in that high point or promontory which forms the tip of the shoulder, and overhangs and defends the joint.

7. This high point is named the ACROMION PROCESS. It is the continuation and ending of the spine, which at first rises perpendicularly from the bone, but by a sort of turn or distortion it lays its flat side towards the head of the shoulder-bone. At this place, it is thickened, flat and strong; overhangs and defends the joint; and is not merely a defence, but almost makes a part of the joint itself; for without this process, the shoulder-bone could not remain a moment in its socket; every slight accident would displace it. The acromion prevents luxation upwards, and is so far a part of the joint, that when it is full under the acromion, the joint is safe; but when we feel a hollow, so that we can push the points of the fingers under the acromion process, the shoulder is luxated, and the socket empty. The point of the acromion, forming the apex of the shoulder, a greater projection of this point, and a fulness of the deltoid muscle which arises from it, is a chief cause, and of course a chief mark, of superior strength.

8. But there is still another security for the joint; for there arises from the neck of the scapula, almost from the border of the socket, and its inner side, a thick, short, and crooked process, which stands directly forwards, and is very conspicuous; and which turning forwards with a crooked and sharp point, somewhat like the beak of a crow, is thence named the CORACOID PROCESS. This also guards and strengthens the joint; though it cannot altogether prevent luxations, it makes them less frequent; and most probably when the arm is luxated inwards, it is by starting over the point of this defending process. A muscle named coracoid, comes down from the joint of this process, and is inserted into the middle of the shoulder-bone, to draw the arm towards the side.

Now the glenoid surface, and these two processes, form the cavity for receiving the shoulder-bone. But still as if nature could not form a joint at once strong and free, this joint, which performs quick, free, and easy motions, is too superficial to be strong. Yet there is this compensation, that the shoulder-joint, which could not resist, if fairly exposed to

shocks and falls, belongs to the scapula, which, sliding easily upon the ribs, yields, and so eludes the force. Falls upon the shoulder do not dislocate the shoulder; that accident almost always happens to us in putting out the hand to save ourselves from falls; and the shoulder is luxated by a twisting of the arm, not by the force of a direct blow.

The CLAVICLE.—The clavicle, or collar bone, named clavicle from its resemblance to an old fashioned key, is to the scapula a kind of hinge or axis on which it moves and rolls; so that the free motion of the shoulder is made still freer by the manner of its connection with the breast.

The clavicle is placed at the root of the neck, and at the upper part of the breast. It extends across from the tip of the shoulder to the upper part of the sternum; it is a round bone, a little flattened towards the end which joins the scapula; it is curved like an Italic *S*; having one curve turned out towards the breast; it is useful as an arch supporting the shoulders, preventing them from falling forwards upon the breast, and making the hands strong antagonists to each other; which, without this steadying, they could not have been.

1. The thoracic end, that next the sternum, or what may be called the inner head of the clavicle, is round and flat, or button-like; and it is received into a suitable hollow on the upper piece of the sternum. It is not only like other joints surrounded by a capsule or purse; it is further provided with a small moveable cartilage, which (like a friction-wheel in machinery) saves the parts, and facilitates the motion, and moves continually as the clavicle rolls.

2. But the outer end of the clavicle is flattened as it approaches the scapula, and the edge of that flatness is turned to the edge of the flattened acromion, so that they touch but in one single point. This outer end of the clavicle, and the corresponding point of the acromion, are flattened and covered with a crust of cartilage: but the motion here is very slight and quite insensible; they are tied firmly by strong ligaments; and we may consider this as almost a fixed point; for there is little motion of the scapula upon the clavicle; but there is much motion of the clavicle upon the breast: for the clavicle serves as a shaft or axis, firmly tied to the scapula, upon which the scapula moves and turns, being connected with the trunk only by this single point, viz. the articulation of the clavicle with the breast bone.

The OS HUMERI is one of the truest of the cylindrical bones; it is round in the middle; but it appears twisted and flattened towards the lower end; and this flatness makes the elbow-joint

a mere hinge, moving only in one direction. It is again regular and round towards the upper end; dilating into a large round head, where the roundness forms a very free and moveable joint, turning easily in all directions.

1. The HEAD of this bone is very large; it is neat and regularly circular; but it is a very small portion of a large circle, so that it is flat; and this flatness of the head, with the shallowness of its glenoid cavity, makes it a very weak joint, easily displaced, and nothing equal to the hip joint for security and strength.

2. The NECK of this bone cannot fairly be reckoned such; for, as I have explained in speaking of the neck of the thigh-bone, this neck of the humerus and the necks of most bones (the thigh-bone still excepted) are merely a rough line close upon the head of the bone, without any straitening or intermediate narrowness, which we can properly call a neck. The roughness round the head of the shoulder-bone is the line into which the capsular ligament is implanted.

3. The TUBEROSITIES of the os humeri are two small bumps of unequal size, (the one called the greater, the other the smaller, tuberosity of the os humeri,) which stand up at the upper end of the bone, just behind the head: they are not very remarkable. Though much smaller than the trochanter of the thigh-bones, they serve similar uses, viz. receiving the great muscles which move the limb. The GREATER TUBEROSITY is higher towards the outer side of the arm, and receives the supra spinatus muscle; while the infra spinatus and teres minor muscles, which come from the lower part of the scapula, are implanted into the bone a little lower. The LESSER TUBEROSITY has also a great muscle fixed into it, viz. the sub-scapularis muscle.

4. The two tuberosities form betwixt them a groove, which is pretty deep; and in it the long tendon of the biceps muscle of the arm runs; and as it runs continually, like a rope in the groove of a pulley, this groove is covered, in the fresh bones, with a thin cartilage, smooth, and like the cartilages of joints.

The os humeri, at its lower part, changes its form, is flattened and compressed below, and is spread out into a great breadth of two inches or more; where there is formed, on each side, a sharp projecting point, (named condyle,) for the origin of great muscles; and in the middle, betwixt the two condyles, there is a grooved articulating surface, which forms the hinge of the elbow.

1. At the lower end of the bone, there are two ridges, one leading to either condyle, which it is of some consequence to observe; for the elbow-joint is a mere hinge, the most strictly

so of any joint in the body; it has, of course, but two motions, viz. flexion and extension; and it has two muscles chiefly, one for extending, the other for bending the arm. The flexor muscle lies on the fore part, and the extensor on the back part of the arm; and so the whole thickness of the arm is composed, at this place, of these two muscles and of the bone; but that the fore and back parts of the arm might be thoroughly divided, the bone is flattened betwixt them; and that the division might extend beyond the mere edges of the bone, there are two fasciæ or tendinous webs which go off from either edge of the humerus, and which continue to divide the fore from the back muscles, giving these muscles a broader origin; they are named, from their office, intermuscular membranes; and this is the meaning of the two ridges which lead to the two condyles.

2. The two projections in which these edges end are named CONDYLES. The condyles of the thigh-bone are the broad articulating surfaces by which that bone is joined with the tibia; while the condyles of the shoulder-bone are merely two sharp projecting points for the origin of muscles, which stand out from either side of the joint, but which have no connection with the joint. The chief use of the condyles of the shoulder-bone is to give a favourable origin, and longer fulcrum, for the muscles of the fore arm, which arise from these points. The outer tubercle being the smaller one, gives origin to the extensor muscles, where less strength is required. But the inner tubercle is much longer, to give origin to the flexor muscles with which we grasp; which require a bolder and more prominent process to arise from; for greater power is needed to perform such strong actions as grasping, bending, pulling; while the muscles which extend the fingers need no more power than just to antagonise or oppose the flexors; their only business being to unfold or open the hand when we are to renew the grasp.

It is further curious to observe, that the inner tubercle is also lower than the other, so that the articulating surface of the elbow-joint is oblique, which makes the hand fall naturally towards the face and breast, so that by being folded merely without any turning of the os humeri, the hands are laid across.

3. The articulating surface which stands betwixt these condyles, forms a more strict and limited hinge than can be easily conceived, before we explain the other parts of the joint. The joint consists of two surfaces; first, a smooth surface, upon which the ulna moves only backwards and forwards; and, secondly, of a small knob upon the inner tuber-

cle, which has a neat round surface, upon which the face or socket belonging to the button-like end of the radius rolls. These two surfaces are called the small head, and the cartilaginous pulley of the humerus.

4. Belonging to the joint, and within its capsular ligament, there are two deep hollows, which receive certain processes of the bones of the fore arm. One deep hollow on the fore part of the humerus, and just above its articulating pulley, receives the horn-like or coronoid process of the ulna, the other receives the olecranon, or that process of the ulna which forms the point of the elbow.

RADIUS AND ULNA.

The radius and ulna are the two bones of the fore arm. The radius, named from its resemblance to the ray or spoke of a wheel; the ulna, from its being often used as a measure. The radius belongs more peculiarly to the wrist, being the bone which is chiefly connected with the hand, and which turns along with it in all its rotatory motions: the ulna, again, belongs more strictly to the elbow-joint; for by it we perform all the actions of extending or bending the arm.

The ulna is in general of a triangular or prismatic form, like the tibia, and the elbow is formed by the ulna alone; for there is a very deep notch or hinge-like surface, which seems as if it had been moulded upon the lower end of the humerus, embraces it very closely; and takes so sure a hold upon the humerus, that it allows not the smallest degree of lateral motion, and almost keeps its place in the dry skeleton without the help of ligaments or muscles; it presents, in profile, somewhat of the shape of the letter S, and therefore is named the SIGMOID CAVITY of the ulna. 2. But this sigmoid cavity were a very imperfect hinge without the two processes by which it is guarded before and behind; the chief of these is the OLECRANON or large bump, which forms the extreme point upon which we rest the elbow. It is a big and strong process, which, checking into a deep hollow in the back of the humerus, serves two curious purposes; it serves as a long lever for the muscles which extend or make straight the fore arm; and when by the arm being extended, it checks into its place, it takes so firm a hold upon the hinge or joint of the os humeri, as to secure the joint in pulling, and such other actions as might cause a luxation forwards. 3. The other process which guards the elbow-joint is named the CORONOID PROCESS, from its horn or pointed form; it stands up perpendicularly from the upper or

fore part of the bone; it forms the fore part of the sigmoid cavity, and completes the hinge. It is useful, like the olecranon, in giving a fair hold and larger lever to the muscles, and in securing the joint; for the arm being extended, as in pulling, the olecranon checks into its place, and prevents luxation forwards; and the arm again being bent, as in striking, pushing, or saving ourselves from falls, the coronoid process prevents luxation backwards. So the joint consists of the olecranon and the coronoid process as the two guards; and of the sigmoid cavity or hollow of articulation betwixt them; but the smaller or upper head of the radius also enters into the joint, and lying upon the inner side of the coronoid process, it makes a small hollow there, in which it rolls; and this second hollow, touching the edge of the sigmoid cavity, forms a double sigmoid cavity; of which the first, or GREATER SIGMOID CAVITY, is for receiving the lower end of the humerus; and the second, or LESSER SIGMOID CAVITY, for receiving the upper head of the radius. 4. The form of the bone being prismatic or triangular, it has, like the tibia, three ridges; one of which is turned towards a corresponding ridge in the radius, and betwixt them the interosseous ligament is stretched; and this interosseous ligament fills all the arch or open space betwixt the radius and ulna, and saves the necessity of much bone; gives as firm an origin to the muscles as bone could have done, and binds the bones of the fore arm together so strongly, that though the ulna belongs entirely to the elbow-joint, and the radius as entirely to the wrist, they have never been known to depart from each other, nor to yield to any force, however great.*

5. The ulna, bigger at the elbow, grows gradually smaller downwards, till it terminates almost in a point. It ends below in a small round head, which is named the LOWER HEAD of the ulna, which scarcely enters into the joint of the wrist; but being received into a hollow on the side of the radius, the radius turns upon the lower head of the ulna, like an axis or spoke.

6. Below this little head, the bone ends towards the side of the little finger in a small rounded point, which is named the STYLOID PROCESS of the ulna, and which is chiefly useful in giving a strong adhesion to the ligament which secures the wrist there. And as the styloid process and the olecranon, the two extremities of the ulna, are easily and distinctly felt,

* Sometimes the radius is luxated from the lower head of the ulna; but this diastasis, as it is called, is quite of another kind.

the length of this bone has been used as a measure ; and so it was named cubitus by the ancients, and is named ulna by us.

RADIUS. The radius is the second bone of the fore arm, has its position exactly reversed with that of the ulna: for the ulna belonging to the elbow has its greater end upwards ; the radius belonging to the wrist has its greater end downwards ; and while the ulna only bends the arm, the radius carries the wrist with a rotatory motion ; and so entirely belongs to the wrist, that it is called the manubrium manus, as if the handle of the hand.

1. The BODY of the radius is larger than that of the ulna. The transverse strength of the arm depends more upon the radius, which has more body and thickness ; is more squared ; and is arched, in some degree, so as to stand off from the ulna, without approaching it, or compressing the other parts. The radius lies along the upper edge of the fore arm, next to the thumb, and being, like the ulna, of a prismatic or triangular form, it has one of its angles or edges turned towards the ulna to receive the interosseous ligament.

2. The UPPER HEAD of the radius is smaller ; of a round, flattish, and button-like shape, and lies so upon the lower end of the shoulder-bone, and upon the coronoid process of the ulna, that it is articulated with either bone ; for, 1st, The hollow of its head is directly opposed to the little head of the os humeri ; and 2dly, The flat side of its button-like head rubs and turns upon the side of the coronoid process of the ulna, making a socket there, which is called the lesser sigmoid cavity of the ulna.

3. Immediately behind the round flat head, is a narrowness or straitening, called the NECK of the radius. Round this neck there is a collar or circular ligament (named the coronary ligament of the radius), which keeps the bone securely in its place, turning in this ligamentous band like a spindle in its bush or socket : for the radius has two motions, one accompanying the ulna in its movements of flexion and extension ; and, secondly, its own peculiar rotation ; in which it is not accompanied in return by the ulna, but the ulna continuing steady, the radius moves, and turns the wrist.

4. Immediately under this neck, and just below the collar of the bone, there is a prominent bump, like a flat button, soldered upon the side of the bone ; which is the point into which the biceps flexor cubiti, or bending muscle of the fore arm, is inserted.

5. The upper head is exceedingly small and round, while the LOWER HEAD swells out, broad and flat, to receive the bones of the wrist. There are two greater bones in the wrist,

which form a large ball, and this ball is received into the lower end of the radius: the impression which these two bones make there is pretty deep, and somewhat of a boat-like shape; whence it is called (like the articulating surface of the tibia) the scaphoid cavity of the radius; and on the edge of the radius, next to the thumb, the bone ends in a sort of peak or sharper point, which is named (though with very little meaning) the STYLOID PROCESS of the radius.

So the scaphoid cavity of the radius forms the joint with the wrist; but there is another small cavity, on the side of the radius, near to the little head of the ulna, into which this lesser head of the ulna is received; and this is inclosed in a proper and distinct capsule. The little head of the ulna does not descend so low as to have any share in forming the wrist. There are properly two distinct joints; the great joint of the wrist, moving upon the radius, the other a little joint within this of the radius, rolling upon the ulna, and carrying the wrist along with it.

OF THE HAND AND FINGERS.

The wrist is the most complex part of all the bony system, and is best explained in a general way, by marking the three divisions of the hand, into the carpus or wrist bones; the metacarpus, or bones that stand upon the wrist; and the fingers, consisting each of its three joints. 1. The carpus or wrist is a congeries of eight small bones; grouped together into a very narrow space; very firmly tied together by cross ligaments; making a sort of ball or nucleus, a solid foundation or centre for the rest of the hand. 2. The metacarpus is formed of five long bones, founded upon the carpal bones; and which, departing from that centre, in somewhat of a radiated form, give, by their size and strength, a firm support to each individual finger, and, by their radiated or spoke-like form, allow the fingers freer play. 3. The fingers, consisting each of three very moveable joints, are set free upon the metacarpus; so as to show a curious gradation of moving in all these parts; for the carpal bones are grouped together into a small nucleus, firm, almost immoveable, and like the nave of a wheel; then the metacarpal bones, founded upon this, are placed like the spokes or fellies of the wheel, and have a freer motion; and lastly, the fingers by the advantage of this radiated form in the bones upon which they are placed, move very nimbly, and have a rotatory as well as a hinge-like motion. So that the motion is graduated and proportioned in

each division of the hand; and even where there is no motion, as in the carpus, there is an elasticity, which, by gentle bendings, accommodates itself to the more moveable parts.

The CARPUS, or WRIST.—Looking upon the external surface of the carpus, we count eight small bones disposed in two rows, with one bone only a little removed from its rank; and we observe that the whole is arched outwards, to resist injuries, and to give strength; and that the bones lie like a pavement, or like the stones of an arch, with their broader ends turned outwards. On the internal surface again, we find the number of bones not so easily counted; for their smaller ends are turned towards the palm of the hand, which being a concave surface, the narrow ends of the wedges are seen huddled together in a less regular form, crowded, and lapped over each other; but in this hollow, the four corner bones are more remarkable, projecting towards the palm of the hand, so as to be named processes: and they do indeed perform the office of processes; for there arises from the four corner points a strong cross ligament, which binds the tendons down, and makes under it a smooth floor or gutter for them to run in.

The individual bones of the carpus are small, cornered, and very irregular bones; so that their names do but very poorly represent their form. To describe them without some help of drawing, or of demonstration, is so very absurd, that a description of each of them seems more like a riddle than like a serious lesson: it cannot be understood, and indeed it need hardly be remembered; for all that is useful is but to remember the connection and place, and the particular uses, of each bone; in reading of which the student should continually return to the plates, or he must have the bones always in his hand.

1. ROW FORMING THE WRIST.

1. Os SCAPHOIDES—The boat-like bone. This name of boat-like bone, or boat-like cavity, has been always a favourite name, though a very unmeaning one. The scaphoid bone is not worthy of notice merely from its being the largest, but also as it forms a chief part of the joint of the wrist; for it is this bone which is received into the scaphoid cavity of the radius. It is a very irregular bone; in which we need remember only these two points; the large round surface covered with cartilage, smooth, and answering to the cavity in the head of the radius; and the hook-like, or projecting process, which forms one of the corner points of the carpus, and

gives a hold to one corner of the ligament which binds down the tendons of the wrist.

2. The os LUNARE is named from one of its sides being somewhat of the shape of a half moon; it is next in size to the scaphoid bone, and is equal to it in importance; for they are joined together, to be articulated with the radius. This bone takes an equal share in the joint with the scaphoid bone; and together they form a great ball, fitting the socket of the radius, and of a long form, so that the wrist is a proper hinge. The lunated edge of the os lunare is turned towards the second row of bones, and therefore is not seen. And the chief marks of this bone are its greater size; its lunated edge, turned towards the second row; and its round head forming the ball of the wrist-joint.

3. The os CUNEIFORME, or wedge-like bone, is named rather perhaps from its situation, locked in among the other bones, than strictly from its form. Its side forming the convex of the hand, is broader; its point towards the palm of the hand is narrower; and so far, we may say, it is a wedge-like bone: but it is chiefly so from its situation, closely wedged in betwixt the unciform and pisiform bones.

4. The os PISIFORME is a small neat and round bone, named sometimes ORBICULAR, or round bone, but oftener pisiform, from its resemblance to a pea. It is placed upon the cuneiform bone, and stands off from the rest into the palm of the hand, so as to be the most prominent of all the corner bones; of course it forms one of the corner points or pillars of that arch, under which the tendons pass. The pisiform bone is a little out of its ranks; is very moveable; and projects so into the palm, as to be felt outwardly, just at the end of the styloid process of the ulna; it can be easily moved and rolled about; and is the point into which is implanted one of the strong muscles for bending the wrist.

2. ROW SUPPORTING THE METACARPAL BONES.

5. The second row begins with the TRAPEZIUM; a pretty large bone, which, from its name, we should expect to find of a regular squared form; while it has, in fact, the most irregular form of all, especially when detached from the other bones. The chief parts to be remarked in the bone, are the great socket for the thumb; and as the thumb stands off from one side of the hand, this socket is rather on one side. There is also a little process which makes one of the corner points.

6. The TRAPEZOIDES is next to the trapezium; is some-

what like the trapezium; from which it has its name. It also resembles the cuneiform bone of the first row in its shape and size, and in its being wedged in betwixt the two adjoining bones.

7. The os MAGNUM is named from its great size; not that it is the largest of all, nor even the largest bone of the second row, for the cuneiform bone is as big; but there is no other circumstance by which it is well distinguished. It is placed in the centre of the upper row, has a long round head, which is jointed chiefly with the lunated hollow of the os lunare; and this big head, and lunated hollow, make together a sort of socket, by which the second row moves upon the first.

8. The os UNCIFORME, or hook-like bone, is named from a flat hook-like process, which projects towards the palm of the hand. This is one of the corner bones, and standing in the end of the row, it is wedged betwixt the os magnum of its own row, and the os cuneiforme of the first row. It is large and squared; but the thing chiefly remarkable is that process from which it takes its name; a long and flat process of firm bone, fairly unciform, or hook-like, and projecting far into the palm of the hand, which being the last and highest of the corner points, gives a very firm origin to the great ligament by which the tendons of the wrist are bound down.

All these bones of the carpus, when they are joined to each other, are covered with a smooth articulating cartilage; are bound to each other by all forms of cross ligaments; and are consolidated, as it were into one great joint. They are, in general, so firm as to be scarcely liable to luxation; and although one only is called cuneiform, they are all somewhat of the wedge-like form, with their broader ends outwards, and their smaller ends turned towards the palm of the hand; they are like stones in an arch, so that no weight nor force can beat them in; if any force do prevail, it can beat others in only by forcing one out. A bone starting outwards, and projecting upon the back of the hand, is the only form of luxation among these bones, and is extremely rare.

METACARPUS.—The metacarpus is composed of five bones, upon which the fingers are founded. They are big strong bones; brought close together at the root, but wider above; for the lower heads are small and flat, and grouped very closely together, to meet the carpal bones; but they swell out at their upper ends into big round heads, which keep the bones much apart from each other. Nothing of importance can be said concerning the individual bones. To speak of them individually is a mere waste of time. We may observe

of the metacarpal bones in general, 1. That their lower heads being flat and squared, gives them a firm implantation upon their centre or nucleus, the carpus; and that they have scarcely any freer motion upon the carpal bones, than the carpal bones have upon each other. 2. That their upper heads being larger, keeps the bones apart from each other; and in the interstices between them lie the interosseous muscles. 3. That their divergence regulates the radiated or spreading form of the fingers, and gives them free play. And, 4. That they still preserve the arched form of the carpal bones, being, with the carpal bones, convex outwardly, and concave inwardly, to form the hollow of the hand; and though they have little motion of flexion or extension, they bend towards a centre, so as to approach each other, increasing the hollowness of the hand, to form what is called Diogenes's cup. It is farther necessary to observe, into how small a space the carpal bones are compressed; how great a share of the hand the metacarpal bones form; and how far down they go into the hollow of the hand. For I have seen a surgeon, who, not having the smallest suspicion that their lower ends were so near the wrist as they really are, has, in place of cutting the bone neatly in its articulation with the carpus, broken it, or tried to cut it across in the middle.

FINGERS.—We commonly say, that there are five metacarpal bones; in which reckoning we count the thumb with the rest: but what is called the metacarpal of the thumb is properly the first phalanx, or the first proper bone of the thumb; so that the thumb, regularly described, has, like the other fingers, three joints.

THUMB.—The first bone of the thumb resembles the metacarpal bones in size and strength, but it differs widely in being set upon the carpus with a large and round head; in being set off from the line of the other fingers, standing out on one side, and directly opposed to them. It rolls widely and freely, like other ball and socket joints; it is opposed to the other fingers in grasping, and, from its very superior strength, the thumb is named Polex, from polere.

The FINGERS have each of them three bones. 1. The first bone is articulated with the metacarpal bones by a ball and socket; the socket, or hollow on the lower part of the first finger bone, being set down upon the large round head of the metacarpal bone. 2. The second and third joints of the fingers are gradually smaller, and though their forms do a good deal resemble the first joint, they are quite limited in their motions; have no rolling; are as strictly hinge-joints as the knee

or ankle are. 3. Here, as in other hinge-joints, the capsule is so particularly strong at the sides, as to be named lateral ligaments. When these lateral ligaments are burst or cut, the finger turns in any direction, so that the motions of the fingers are limited rather by their lateral ligaments, than by any thing peculiar in the forms of the bones. 4. The face of each finger bone is grooved, so that the tendons, passing in the palm of the hand, run upwards along this groove or flatness of the fingers; and from either edge of this flatness, there rises a ligament of a bridge-like form, which covers the tendons like a sheath, and converts the groove into a complete canal. 5. The last joint or phalanx of each finger is flattened, rough, and drawn smaller gradually towards the point of the finger; and it is to this roughness that the skin and nail adhere at the point.

BOOK II.

OF THE MUSCLES.

CHAP. I.

MUSCLES OF THE FACE, EYE, AND EAR.

MUSCLES OF THE FACE.

I. THE OCCIPITO FRONTALIS is a broad and thin muscular expansion, which covers all the upper part of the cranium. It consists of two bellies, with an intermediate sheet of flat tendon. The one belly covers the occiput; the other covers the forehead; and the tendinous expansion covers all the upper part of the head: by which it has happened that the most eminent anatomists, as Cowper (p. 29.) have misnamed its tendon, pericranium: many have reckoned it two distinct muscles, viz. the OCCIPITAL and FRONTAL; while others (because of a sort of rapha, or line of division in the middle of each belly) have described four muscles, viz. two frontal and two occipital muscles. But it is truly a double bellied muscle; and the broad thin tendon, which belongs equally to both bellies, lies above the true pericranium, and slides upon it. The muscle is therefore named, with strict propriety, OCCIPITO-FRONTALIS, sometimes EPICRANEUS, sometimes BIVENTER or DIGASTRICUS CAPITIS.

ORIGIN.—The occipital portion is the fixed point of this muscle; arising from the upper ridge of the occipital bone, and covering the back part of the head, from the mastoid process of one side, round to that on the opposite side of the head. And by the perpendicular ridge of the occiput, it is marked with a slight division in the middle.

INSERTION.—The fore belly of the muscle which covers the forehead, is fixed more into the skin and eyebrows than into the bone; it is slightly attached to the bone, near the inner end of the orbitary ridge, and especially about the inner corner of the eye, and the root of the nose, by a smaller and acute

pointed process ; but still its chief attachment is to the eye-lids and skin.

The TENDON or thin MEMBRANEOUS expansion which joins the two bellies, is exceedingly thin : it has on its inner side much loose cellular substance, by which, though attached to the true pericranium, it slides easily and smoothly upon it ; but its outer surface is so firmly attached to the skin, and its fore belly adheres so firmly to the eyebrows, that it is very difficult to dissect it clean and fair.

I consider the occipital belly as the fixed point, having a firm origin from the ridge of the bone ; its frontal belly has the loose end attached, not to the os frontis, but to the eyebrow and skin ; and its office is to raise the eyebrows, wrinkle the forehead, and corrugate the whole of the hairy scalp, like that muscle under the skins of animals which shrinks when they are cold or rudely touched, and by which they shake off flies or insects. But it is a muscle employed more in expressing passions than in performing useful motions ; and it is often so thin as hardly to be perceived. In some it is entirely wanting ; and many who have the muscle, have no command nor power over it.

There is a small, neat and pointed slip of the occipito-frontalis, which goes down with a peak towards the nose, and is inserted into the small nasal bone. This process, being much below the end of the eyebrow, must pull it downwards ; so that while the great muscle raises the eyebrow and skin of the forehead, this small nasal slip pulls the eyebrow downwards again, restoring it to its place, and smoothing the skin. It may be considered as the antagonist of the great occipital and frontal bellies, and might almost be described as a distinct muscle.

II. The CORRUGATOR SUPERCILII is another slip which might be fairly enough referred, like this, to the occipital muscle ; but being in many subjects particularly strong, it is best described as distinct. The lower end of the nasal slip of the occipito-frontalis is fixed to the nasal bone ; the lower end of the little slip, the corrugator supercilii, is fixed into the internal angular process ; and from the inner angle of the eye, the fibres sweep round the edge of the orbit, and going obliquely upwards and outwards, are so mixed with the fibres of the frontal muscle, and of the orbicularis oculi, where these two touch each other, that it is doubtful to which of those greater muscles this little one might be most properly referred. So this slip of oblique fibres, rising from the inner angle of the eye, and being fixed into the eyebrow, also antagonizes the occipito-frontalis ; and drawing the eyebrows together, and

wrinkling the space betwixt them, is very rightly named CORRUGATOR SUPERCILII.

III. ORBICULARIS OCULI, or PALPEBRARUM, is a neat and regular muscle, surrounding the eye, and covering the eyelids in a circular form. It is exceedingly flat and thin; is about an inch in breadth; lies immediately under the skin of the eyelids; and is immediately attached to them, and but little connected with the bone. It has one small tendon in the inner corner of the eye, which is both its origin and insertion; for it begins and ends in it. This small tendon is easily felt through the skin in the inner corner of the eye. It arises by a little white knot from the nasal process of the upper jaw-bone. Its fibres immediately become muscular, and spread out thin over the upper eyelid. They pass over it to the outer corner of the eye, where they cross a little, and having covered just the edge of the temple with their thin expanded fibres, they return in a circular form round by the lower eyelid to the point from whence they had set out. This is, in all its course, a very thin muscular expansion, with regular orbicular fibres. It is rather a little broader over the lower eyelid; extends itself a little upon the face beyond the brim of the socket, both at the temple and upon the cheek; and its fibres cross each other a little at the outer angle; so that some, understanding this crossing as a meeting of fibres from the upper and from the lower muscle, have described it as two semicircular muscles. And those fibres which are next to the tarsus or cartilaginous circle of the eyelids, were distinguished by Riolan under the title of MUSCULUS CILIARIS. Our name expresses the common opinion, that it is a circular muscle, whose chief point or fulcrum is in the inner corner of the eye, and which serves as a sphincter for closing the eye. It squeezes with spasmodic violence when the eye is injured, as by dust. And by its drawing down the eyelids so firmly, it presses the ball of the eye down into the socket, and forces the lachrymal gland that is within the socket, so as to procure a flow of tears. Perhaps the corrugator supercilii belongs strictly to this muscle, since its fibres follow the same course.

IV. LEVATOR PALPEBRÆ SUPERIORIS. This small muscle arises deep within the socket, from the margin of that hole which gives passage to the optic nerve. It begins by a small flat tendon in the bottom of the optic cavity; becomes gradually broader as it goes over the eyeball; it ends in the eyelid by a broad expansion of muscular fibres, which finally terminate in a short flat tendon. It lies under the orbicularis palpebræ; is inserted into the whole length of the cartilage of the tarsus; and raises and opens the upper eyelid. And the division of

the orbicularis oculi into two, by the older anatomists, was a consequence of their not knowing of the true levator palpebræ, and their not being able to describe any muscle by which the upper eyelid could be raised, except the upper half of the orbicularis.

The occipito-frontalis, but especially its occipital belly, raises the eyebrows; the pointed slip of the same muscle pulls them downwards; the corrugator pulls them directly inwards, and knits the brows; the levator palpebræ opens the eyelid; and the orbicularis oculi closes the eye. Whether certain fibres from the platisma-myoides (a thin flat muscle which mounts from the neck over the cheek) may not pull down the lower eyelid; or whether some straggling fibres, arising from the zygoma, may not have the appearance of a depressor of the lower eyelid, it is not necessary to determine, since there is no regularly appointed muscle; and the lower eyelid is almost immoveable, at least in man.

MUSCLES OF THE NOSE AND MOUTH.

V. Levator labii superioris et alæ nasi. Cowper describes the levator labii superioris as an irregular production of the frontalis, extending along the nostrils. But it is a neat and delicate muscle, which arises, by a small double tendon, from the nasal process of the upper jaw-bone, close by the tendon of the orbicularis oculi. It is one little fasciculus of muscular fibres above; but as it approaches the nose, it spreads out broader, dividing into two small fasciculi; one of which is implanted into the wing or cartilage of the nose, and the other passing the angle of the nose, goes to the upper lip. Thus it is pyramidal with its base downwards, and was named pyramidalis by Caserius, Winslow, and others. It is called by Cowper dilator alæ nasi. It raises the upper lip, and spreads the nostrils wide, as is observed in a paroxysm of rage, or in asthmatics.

VI. The levator labii superioris proprius, is distinguished by the name of levator proprius, because there are two others; one belonging to the angle of the mouth, and consequently to both lips; and one common to the lip and nostril.

The levator proprius is often named musculus incisivus, because it arises from the upper-jaw, just above the incisores or cutting teeth, and consequently just under the edge of the orbit: it is broad at its origin; it lies flat, and runs downwards, and obliquely inwards, to the middle of the lip, till it

meets its fellow just in the filtrum.* It pulls the upper lip and the septum of the nose directly upwards.

VII. The LEVATOR ANGULI ORIS, is called also LEVATOR COMMUNIS LABIORUM, because it operates equally on both lips. It is named CANINUS ; for as the last named muscle rises from the upper jaw-bone above the incisores or cutting teeth, this arises above the canini or dog teeth, or above the first grinder, by a very short double tendon. The exact place of its origin is half-way betwixt the first grinder and the infra orbitary hole : it is mixed with the orbicularis oris at the corner of the mouth, so that it raises the angle of the mouth upwards.

VIII. The ZYGOMATICUS MAJOR has nearly the same direction and use with this one : for it arises from the cheek-bone near the zygomatic suture ; runs downwards and inwards to the corner of the mouth ; is a long and slender muscle, which ends by mixing its fibres with the orbicularis oris and the depressor of the lip.

IX. The ZYGOMATICUS MINOR arises a little higher upon the cheek-bone, but nearer the nose ; it is much slenderer than the last, and is often wanting.

It is the zygomatic muscle that marks the face with that line which extends from the cheek-bone to the corner of the mouth, and which is so strong in many. The zygomatic muscles pull the angles of the mouth upwards as in laughter ; or distort the mouth ; whence the zygomatic muscle has gotten the name of distortor oris ; and the strong action of the muscle is particularly seen in laughter, rage, grinning.

X. BUCCINATOR. The buccinator was long thought to be a muscle of the lower jaw, arising from the upper alveoli, and inserted into the lower alveoli to pull the jaw upwards ; but its origin and insertion, and the direction of its fibres, are quite the reverse of this. For this large flat muscle, which forms, in a manner, the walls of the cheek, arises chiefly from the coronoid process of the lower jaw-bone, and partly also from the end of the alveoli or socket process of the upper jaw, close by the pterygoid process of the sphenoid bone : it goes forwards with direct fibres to be implanted into the corner of the mouth : it is thin and flat, covers in the mouth, and forms the walls of the cheek, and is perforated in the middle of the cheek by the duct of the parotid gland. These are its principal uses : that it flattens the cheek, and so assists in swallowing liquids : that it turns, or helps to turn, the morsel in the mouth

* The filtrum is the superficial gutter along the upper lip from the partition of the nose to the tip of the lip.

while chewing, and prevents it from getting without the line of the teeth: in blowing wind instruments, it both receives and expels the wind: it dilates like a bag, so as to receive the wind in the cheeks; and it contracts upon the wind, so as to expel the wind, and to swell the note. In blowing the strong wind instruments, we cannot blow from the lungs, for it stresses the breathing, but reserve the air in the mouth, which we keep continually full; and from this it is named, from blowing the trumpet, the BUCCINATOR.

XI. DEPRESSOR ANGULI ORIS.—The depressor anguli oris is a neat small triangular muscle, and is indeed very commonly named MUSCULUS TRIANGULARIS LABIORUM, from its shape. The base of the triangle is at the line of the lower jaw, where the muscle rises with a flat fleshy head about an inch in breadth. It grows smaller gradually as it rises towards the corner of the mouth, where it is implanted, small, almost in a point, and directly opposite to the zygomatic and levator muscles; and as the zygomatic muscle makes a line from the cheek down to the angle of the mouth, this makes a line from the chin up to the corner of the mouth. It is chiefly active in expressing the passions, and gives form to the chin and mouth. In cheerful motions, as laughter, smiling, &c. the zygomatics and levators pull the angles of the mouth upwards. In fear, hatred, revenge, contempt, and the angry passions, the triangulares pull the corners of the mouth downwards. And, at the place where these meet, there is formed a sort of rising at the angle of the mouth: for a great many tendons are crowded into this one point; the zygomatic levator, depressor, and orbicularis oris muscles meeting and crossing each other at this place.

XII. The DEPRESSOR LABII INFERIORIS is a small muscle, the discovery of which Cowper claims for himself. It is a small muscle, lying on each side of the chin, which, with its fellow, resembles very much the levators of the upper lip. The depressor labii inferioris arises on each side of the chin, from the lower jaw-bone, under the line of the triangular muscle. It goes obliquely upwards and inwards, till it meets its fellow in the middle of the lip; and where the muscles of the opposite side meet, there is a little filtrum or furrow on the lower lip, as on the upper one. It mixes its fibres with the orbicularis, and its use is to pull the lip downwards. Each muscle is of a square form, and thence has been often named QUADRATUS GENÆ, the square muscle of the chin.

XIII. The ORBICULARIS ORIS, or muscle round the mouth, is often named CONSTRICTOR ORIS, SPHINCTER, or OSCULATOR. It is very regular: it is an inch in breadth, and con-

stitutes the thickness of the lips : it lies in the red part of the lips, and is of a circular form, surrounding the mouth after the same manner that the orbicularis oculi encircles the eye. We see a degree of crossing in the fibres at the angles of the mouth, whence it has been considered by many, not as a circular muscle, but as one consisting of two semicircular muscles, the SEMI-ORBICULARIS SUPERIOR, and SEMI-ORBICULARIS INFERIOR. Its fixed points are the two angles of the mouth ; at that swelling which is formed by the union of the zygomatic, triangular, and other muscles : and its chief use is to contract the mouth, and to antagonize the other muscles which I have just described. Often a small slip runs up from the middle of the upper lip to the tip of the nose ; it is the NASALIS LABII SUPERIORIS of Albinus ; it lies exactly in the furrow of the filtrum, and is occasionally a levator of the upper lip, or a depressor of the tip of the nose.

These muscles of the nose and lips are not useful merely in expressing the passions ; that is but a secondary and accidental use, while their great office is to perform those continual movements which breathing, speaking, chewing, swallowing, require. There are muscles for opening the mouth in various directions, which are all antagonized by this one, the orbicularis oris. The levator labii superioris, and the depressor labii inferioris, separate the lips, and open the mouth. The levator anguli oris, along with the zygomatic muscles, raises the cheek and dilates the corners of the mouth. The buccinator pulls the corner of the mouth directly backwards, opening the mouth. The angularis oris also dilates the mouth, pulls the angles of the mouth downwards and backwards, and forms it into a circle, if the others act at the same time ; but the orbicularis oris is the largest and strongest (formed, as it were, by the fibres of all these taking a new direction, and turning round the lips), shuts the mouth, and antagonizes them all : and from an opening as wide as the mouth can require, shuts the mouth at pleasure, so closely as to retain the very breath against all the force of the lungs. It is the true antagonist of all the other muscles ; and they and the orbicularis mutually react on each other, in alternately opening and closing the mouth. This phenomenon of the orbicularis muscle dilating to such a wideness, and in an instant closing the mouth again with such perfect accuracy as to retain the breath, puts to nought all the vain calculations about the contraction of muscles; as that they can contract no more than one third of their length ; for here is an infinite contraction, such as no process can measure. It is a paralysis of these muscles, that so often occasions a hideous distortion of the face ; for when the one side of the body

falls into palsy, the muscles of one cheek cease to act; the muscles of the other cheek continue to act with their usual degree of power. This contraction of the muscles of one cheek excites also the orbicularis oris to act, and so the mouth is pursed up, and the lips and angles of the mouth are drawn towards one side.

There are some smaller muscles which, lying under these, could not be described without danger of confusion; as—

XIV. The DEPRESSOR LABII SUPERIORIS ALÆ ET NASI, which is very small, and lies concealed under the other muscles. It rises from the gum or socket of the fore teeth, and thence is named by Winslow incisivus medius. It goes into the rising of the nose, and pulls it, and of course the upper lip down; and is named by Albinus and Cowper constrictor vel compressor alæ nasi.

XV. The CONSTRICTOR NASI, or compressor of the nose, is a small scattered bundle of muscular fibres, which crosses the wings, and goes to the very point of the nose; for one arises from the wing of the nose on each side, and meets its fellow in the middle ridge, where both are fixed into the middle cartilage, or into the lower point of the NASAL bones; meeting with the peak of the frontal muscle, or its scattered fibres. But this muscle is so difficultly found, that when Cowper saw it distinctly marked in Bidloe's 12th table, he considered it as a fiction, having sought for it very carefully, but in vain.

And XVI. The LEVATOR MENTI, which arises from the lower jaw, at the root of the cutting teeth, has been named INCISIVUS INFERIOR. It is inserted into the skin, on the very centre of the chin: by its contraction it draws the centre of the chin into a dimple; and from its moving under the lip at the same time, it is named LEVATOR LABII INFERIORIS.

MUSCLES OF THE EXTERNAL EAR.

THOUGH perhaps not one of ten thousand has the power of moving the outward ear, yet there are many thin and scattered fibres of muscles about the root of the cartilage of the ear, to which we cannot refuse the name and distinction of muscles; and which serve, indeed, to indicate that nature had intended a degree of motion, which, perhaps by the manner of covering the heads of children, we may have lost. But in a few these fasciculi of fibres have not the form only, but the uses also, of muscles. The celebrated Mr. Mery was wont, when lecturing on this subject, to amuse his pupils, saying, pleasantly, "that "in one thing, he surely belonged to the long-eared tribe;"

upon which he moved his ears very rapidly backwards and forwards.*

XVII. SUPERIOR AURIS is named ATTOLLENS, because it lifts the ear upwards: it is a very thin, flat expansion, which can hardly be distinguished from the fascia of the temporal muscles, upon which it lies; it arises broad and circular from the expanded tendon of the occipito-frontalis, and is inserted narrow into the root of the cartilaginous tube of the ear.

XVIII. ANTERIOR AURIS is a very delicate, thin and narrow expansion; arising about the zygoma, or rather from the fascia with which the zygoma is covered; it is implanted round the cartilaginous tube, at its root.†

XIX. The POSTERIOR AURIS is also a small muscle, very delicate and thin; but the anterior rises in one small and narrow slip only, while this, the posterior, rises commonly in three narrow and distinct slips, from about the place of the mastoid process;‡ whence it is often named TRICEPS AURIS. It goes directly forwards to be implanted into the concha. It is named RETRAHENS AURIS from its office.

But there are still other muscles enumerated, which are not for moving the outward ear upon the head, but for moving or rather bending the individual parts of the ear upon each other. Those fibres, which are misnamed muscles, are merely muscular membranes, which have none of the marks nor offices of true muscles; they have seldom fleshy fibres, and the parts upon which they lie are fixed. Heister denies them the title of muscles, and calls them muscular membranes only.

The ring and other bendings of the outward ear are called helix and antihelix, tragus and antitragus; and this determines the names of these ambiguous fibres, which are sometimes found lying upon these circles of the outward cartilage, just under the skin.

XX. The MUSCULUS HELICIS MAJOR lies upon the upper or sharp point of the helix, or outward ring.

XXI. HELICIS MINOR rises lower than the former, upon the part of the helix.

XXII. The TRAGICUS lying upon the concha, and stretching to the tragus.

XXIII. The ANTITRAGICUS lies in the antitragus.

XXIV. And lastly, There is the TRANSVERSUS AURIS of Albinus.

* Vide Palfin, who was his pupil. The celebrated Albinus could move his ears.

† We seldom find an anterior auris, or any thing different from the anterior fibres of the attollens.

‡ Fibræ carnæ transversæ, a nobis descriptæ VALSALVA.

MUSCLES OF THE EYEBALL.

The eyeball is entirely surrounded by muscles, which turn it in all directions. There is one muscle on either side; one above, and one below; these arise from the very bottom of the socket, spread out upon the ball of the eye, and are implanted into its fore part, where the expansions of their colourless tendons form what is called the white of the eye. Now, these four muscles being directly above, below, and on either side of the eye, are called the recti, or straight muscles; for their pulling is from the bottom of the socket. But there are other two muscles which are named the oblique muscles, because they pull from the edges of the socket, and turn the eye obliquely; for they go in a direction exactly opposite to the recti. The recti come directly forwards from the bottom of the orbit; these go obliquely backwards from the edge of the orbit; one rises from the lower edge of the socket, and goes backwards under the eyeball; the other rises indeed, along with the recti, in the bottom of the socket, but it has a cartilaginous pulley on the very edge of the socket at its upper part; and its small round tendon first runs through this pulley, and then turns down upon the eye, and goes backwards; so that the straight muscles press down the eyeball deep into the socket, while the oblique muscles bring the eyeball forwards, pulling it outwards from the socket.

The truest description of the recti is as of one muscle, since their only variety is that of difference of place, which is expressed by the name of each. They all agree in these chief circumstances, that they arise by flat, but small tendons, round the margin of the optic hole, arising from the circle of that hole, or rather from the periosteum there; and there being one above, one below, and one on either side, they completely surround the optic nerve, and adhere to it. They are neat and delicate muscles, gradually expanding each into a fleshy belly, which surrounds and covers the middle of the ball of the eye. They still go on expanding, till they at last terminate, each in a broad, flat, and very white tendon, which covers all the fore part of the eye, up to the circle of the lucid cornea or window; and their white and shining tendons form that enamelled-like part which lies behind the coloured circle, which is, from its colour, named the white of the eye, or the TUNICA ALBUGINEA, as if it were absolutely a distinct coat.

Now, the only difference in these straight muscles is in respect of length; for the optic nerve enters the eye, not regularly in the centre, but a little towards the inner side, so that the

rectus internus, or muscle nearest the nose, is a little shorter. The rectus externus, or muscle nearest to the temple, is a little longer; while the rectus superior and the rectus inferior are nearly of equal length. The uses of these muscles are exceedingly plain.

XXV. The RECTUS SUPERIOR, lifting the eye directly upwards, is named the MUSCULUS ATTOLLENS; the LEVATOR OCULI, or SUPERBUS, as expressive of haughtiness and pride.

XXVI. And the RECTUS INFERIOR, which is directly opposite to it, is named DEPRIMENS OCULI, or HUMILIS, as expressing modesty and submission.

XXVII. The RECTUS INTERNUS is called ADDUCENS, as carrying the eye towards the nose; or BIBITORIUS, because it directs the eye to the cup.

And (XXVIII.) The RECTUS EXTERNUS, the outer straight muscle, as it turns the eye away, is named ABDUCTOR OCULI, or INDIGNABUNDUS, expressing anger or scorn. Such is the effect of these muscles, that when they act in succession, they roll the eye; but if they act all at once, the power of each is balanced by the action of its opposite muscle, and the eye is immovably fixed. So that sometimes in our operations, when the couching needle approaches the eye, fear comes upon the patient, and the eye is fixed by a convulsive action, more firmly than it could be by the instruments, or by the finger; so that the speculum oculi is after such an accident of no use: the eye continues fixed during all the operation, but it is fixed in a most dangerous way, by a power which we cannot controul, and which sometimes, when our operation is for extracting one of the humours only, squeezes out the whole.

XXIX. The OBLIQUUS SUPERIOR arises along with the recti in the bottom of the eye, above and towards the inner side; directing its long tendon towards the inner angle of the eye; and there it passes its tendon through that pulley, whose hollow I have marked in describing the os frontis, as under the superciliary ridge, and near to the inner corner of the eye. It arises by a small tendon, like one of the recti; it goes over the upper part of the eyeball, a long and slender muscle, whence it is often named LONGISSIMUS OCULI, the longest muscle of the eye. It forms a small smooth round tendon, which passes through the ring of the cartilaginous pulley, which is in the margin of the socket. The pulley is above the eye, and projects farther than the most prominent part of the eyeball, so that the tendon returns at an acute angle, and bends downwards before it can touch the eyeball. And it not only returns backwards in a direction opposite to the recti muscles, but it slips flat under the body of the rectus superior, and is spread

out under it upon the middle, or behind the middle of the eye, viz. about half way betwixt the insertion of the rectus and the entrance of the optic nerves.

XXX. The OBLIQUUS INFERIOR is, with equal propriety, named the MUSCULUS BREVISSIMUS OCULI. It is directly opposite to the obliquus superior, in form, place, office, &c.; for it arises from the nasal process of the jaw-bone, in the lower edge of the orbit, at the inner corner of the eye; it is short, flat, and broad, with a strong fleshy belly: it goes obliquely backwards and outwards, lying under the ball of the eye; and it is inserted broad and flat into the ball, exactly opposite to the insertion of the obliquus superior muscle.

These two muscles roll the eye, whence they are named MUSCULI CIRCUMAGENTES, or AMATORII. But they have still another important office, viz. supporting the eyeball, for the operation of its straight muscles; for when these (the obliqui) act, they pull the eye forwards; the straight muscles resist; and the insertion of the oblique muscles at the middle of the eyeball becomes, as it were, a fixed point, a centre or axis round which the eyeball turns under the operation of the recti muscles. The conjoined effect of the oblique muscles is to bring the eyeball forwards from the socket, as in straining the eye to see some distant point. The particular effect of the upper oblique muscle is not to bring the eye forward, but to roll the eye so as to turn the pupil downwards, and towards the nose. And the particular effect of the lower oblique muscle is to reverse this action, to turn the eye again upon its axis, and to direct the pupil upwards and outwards; but the successive actions of all these muscles move the eye in circles, with gradations so exquisitely small, and with such curious combinations as cannot be explained by words.

CHAP. II.

MUSCLES OF THE LOWER JAW, THROAT, AND TONGUE.

MUSCLES OF THE LOWER JAW.

THE lower jaw requires muscles of great power to grind the food; and accordingly it is pulled upwards by the strong temporal, masseter, and pterygoid muscles. But in moving downwards, the jaw almost falls by its own weight; and having little resistance to overcome, any regular appointment of muscles for pulling down the jaw is so little needed, that it is pulled downwards by muscles of such ambiguous office, that they are equally employed in raising the throat, or pulling down the jaw, so that we hardly can determine to which they belong; for the chief muscles of the throat, coming from the lower jaw, must, when the jaw is fixed, pull up the throat; or, when the throat is fixed, depress the jaw.

XXX. The TEMPORAL MUSCLE is the great muscle of the jaw. It arises from all the flat side of the parietal bone, and from the sphenoid, temporal, and frontal bones, in that hollow behind the eye where they meet to form the squamous suture. It arises also from the inner surface of that strong tendinous membrane which is extended from the jugum to the semicircular ridge of the parietal bone. The fibres are bundled together and pressed into a small compass, so that they may pass under the jugum; there they take a new hold upon the inner surface of the jugum, and the muscle is of course pyramidal, its rays converging towards the jugum. Its muscular fibres are intermixed with strong tendinous ones; it is particularly tendinous where it passes under the jugum; and it has both strength and protection from that tendinous plate which covers it in the temple. Its insertion is into the horn of the lower jaw-bone; not merely into the tip of the horn, but embracing it all round, and down the whole length of the process, so as to take the firmest hold.

XXXI. The MASSETER is a short, thick, and fleshy muscle, which gives the rounding of the cheek at its back part. It arises from the upper jaw-bone, at the back of the antrum, and under the cheek-bone, and from the lower edge of the

zygoma. It lies upon the outside of the coronoid process, covering the branch of the jaw quite down to its angle. It is particularly strong; has many massy bundles of flesh interspersed with tendinous strings; the parotid gland lies on its upper part, and the duct of the gland (as it crosses the cheek) lies over this muscle. The jaw is very firmly pulled up by these two, which are its most powerful muscles; and when we bite, we can feel the temporal muscle swelling on the flat part of the temple, and this the masseter upon the back part of the cheek.

XXXII. XXXIII. The two PTERYGOID MUSCLES (of which there are four in all, two on either side) are named from their origin in the pterygoid processes of the sphenoid bone. The PTERYGOIDEUS INTERNUS is that one which rises from the internal or flatter pterygoid process, and which goes downwards and outwards to the angle of the jaw on its inside. The PTERYGOIDEUS EXTERNUS arises from the external pterygoid process; and goes not downwards, but almost directly outwards, and is implanted high in the jaw-bone, just under its neck, and connected with its capsular ligament. Now the pterygoideus internus descending to be fixed to the angle of the jaw, is longer and bigger, and is named PTERYGOIDEUS MAJOR. The internal one going directly across, and rather backwards, has less space to traverse, is shorter, and is named PTERYGOIDEUS MINOR.

The jaw is moved chiefly by these muscles; the temporalis acting upon the coronoid process like a lever; the masseter acting upon the angle, and before it; and the pterygoideus internus balancing it within, like an internal masseter fixed to the inside of the angle. All these pull strongly upwards for biting, holding, and tearing with the teeth. And the external or lesser pterygoid muscle going from within outwards, pulls the jaw from side to side, and performs all the motions of chewing and grinding, *i. e.* of rotation, so far as the lower jaw possesses that kind of motion.

MUSCLES OF THE THROAT AND TONGUE.

The MUSCLES of the THROAT and TONGUE cannot be understood without a previous acquaintance with certain cartilages and bones, which form the basis of the throat and tongue, and the centre of those motions which we have next to describe.

The OS HYOIDES is a small bone resembling, in shape at least, the jaw-bone. It has a middle thicker part, named its basis, which is easily felt outwardly; it corresponds in place

with the chin, and is distinguished about an inch below the chin; the uppermost of the hard points which are felt in the forepart of the throat. Next, it has two long horn-like processes, which go backwards along the sides of the throat, called the cornua, or horns of the os hyoides; and which are tied by a long ligament, which comes down from the styloid process of the temporal bone. And, lastly, It has small cartilaginous pieces or joinings, by which the horns are united to the basis; and often in the adult this joining is converted into bone. At this point where the two horns go backwards, like the legs of the letter V, there are commonly at the gristly part of the os hyoides two small perpendicular processes which stand up from the joining of the horns to the body; and these are named the appendices of the os hyoides or the lesser cornua.

Now this os hyoides forms by its basis the root of the tongue; thence it is often named the bone of the tongue. It forms at the same time the upper part of the trachea, or windpipe; and it carries upon it that cartilage named epiglottis, which, like a valve, prevents any thing getting down into the windpipe. Its horns extend along the sides of the throat, keeping the openings of the windpipe and gullet extended as we would keep a bag extended by two fingers. The chief muscles of the tongue and of the windpipe arise from its body; the chief muscles of the gullet arise from its horns, and especially from their points; it receives the chief muscles which either raise or depress the throat; and it is the point d'appui, or fulcrum for all the muscles of the throat and tongue, and the centre of all their motions. It is the centre of the motions of the tongue; for it is the origin of these muscles which compose chiefly the bulk of the tongue; of the motions of the trachea or windpipe, for it forms at once the top of the windpipe, and the root of the tongue, and joins them together; of the motions of the pharynx or gullet, for its horns surround the upper part of the gullet, and join it to the windpipe; and it forms the centre for all the motions of the throat in general, for muscles come down from the chin to the os hyoides, to move the whole throat upwards; others come up from the sternum, to move the throat downwards; others come obliquely from the coracoid process of the shoulder-blade, to move the throat backwards, while the os hyoides still continues the centre of all these motions.

The TRACHEA, or WINDPIPE, is that tube which conveys the air to the lungs; and the LARYNX is the head, or figured part of that tube which is formed like a flute for the modulation of the voice, and consists of cartilages, that it may stand

firm and uncompressed, either by the passage of the food, or by the weight of the outward air; and that it may resist the contraction of the surrounding parts, serving as a fulcrum for them in the motions of the jaw, tongue and gullet. Its cartilages are, first, the SCUTEFORM, or THYROID cartilage, which is named from its resemblance to a shield, or rather it is like the flood-gates or folding doors of a canal, the meeting of the two sides being in the middle line of the throat. This prominent line of the thyroid cartilage is easily felt in the middle of the throat; is about an inch in length, and makes that tumour which is called pomum Adami. The flat sides of the thyroid cartilage form the sides of the flute part of the trachea. And there are two long horns at its two upper corners, which rise like hooks above the line of the cartilage, and are joined to the horns of the os hyoides; and two similar, but shorter hooks below, by which it embraces the cricoid cartilage.

The CRICOID CARTILAGE is next to the thyroid, and below it; it is named from its resemblance to a ring: it is indeed like a ring or hoop, but it is not a hoop equally deep in all its parts, it is shallow before, where it ekes out the length of the thyroid cartilage, and is deeper behind, where it forms the back of this flute-like top of the trachea; it is the top ring of the trachea, and the lower ring of the larynx or flute part of the windpipe. And upon its back, or deeper part, are seated those two small cartilages, which form the opening for the breath.

The ARYTENOID CARTILAGES are two small bodies, of the size of peas. They are foolishly described with cornua, ridges and surfaces, when they are so small that nothing further can be observed of their forms than that they are somewhat triangular; that the base or broad part of each sits down upon the upper edge of the cricoid cartilage at its back; that the point of each stands directly upwards, and is a very little crooked, or hook-like, that standing as they do, a little apart from each other, they form together an opening something like the spout of a ewer, or strouped basin, whence their name. And these cartilages being covered with the common membrane of the throat, which is thick, and full of mucous glands, the opening gets a regular appearance with rounded lips; and this opening, or slit between them, which is something like the slit for the thill in the top of a counter, and which slants obliquely downwards, is named the RIMA GLOTTIDIS, or chink of the glottis; and these cartilages being fixed on the cricoid cartilage by a regular hinge, they form the voice by their nearness and the narrowness of the slit; and modify it by their motions, which are so exquisitely minute, that for every changing of the note, (and there are some thousand gradations in the compass of the voice,) they move in a proportional degree.

The EPIGLOTTIS is a fifth cartilage of the trachea, belonging to it both by connection and by office. It is a broad triangular cartilage, not so hard as the others, very elastic, and so exactly like an artichoke leaf, that no other figure can represent it so well. Its office is to defend the opening of the glottis. It is fixed at once to the os hyoides, to the thyroid cartilage, and to the root of the tongue, and it hangs obliquely backwards over the opening of the rima, or chink of the glottis; it is suspended by little peaks of the membrane, which we call ligaments of the glottis, and it is said to be raised or depressed by muscles, which yet are not very fairly described. But the rolling of the morsel which is swallowed, and the motion of the tongue, are sufficient to lay it flat over the rima, so that it is a perfect guard.

Then this is the constitution of the larynx. It is of hard cartilages to resist compression, and of a flute form at its opening, to regulate the voice. The THYROID cartilage is the great one, the chief defence before, and which has edges slanting far backwards, to defend the opening of the larynx. The CRICOID cartilage, which forms the upper ring of the trachea, supports the arytenoid cartilages, and by its deepness behind, raises them so that the opening of the glottis is behind the middle of the great thyroid cartilage, and in the deepest part of it, well defended by its projecting wings. The ARYTENOID cartilages form the rima glottidis, the chink by which we breathe, (which, as it is narrower or wider, modulates and tunes the voice,) the opening which is so exquisitely moved by its muscles in singing; widening or contracting in most delicate degrees; and which is so spasmodically shut by the same muscles when it is touched by a drop of water, or by a crumb of bread: but the valve of the glottis, the EPIGLOTTIS, standing over it, flaps down like the key of a wind instrument, so that the rareness of such accidents is wonderful, when we consider that the least attempt to draw the breath while we are swallowing, will produce the accident.

The muscles which move the tongue and throat must be far too complicated to be explained at all, without some previous knowledge of these parts; and still, I fear, not easily to be explained with every help of regularity and order.

MUSCLES OF THE THROAT.

By this arrangement, I mean to include under one class all those muscles which move the os hyoides, or the larynx; and through these, as centrical points, the jaws, gullet, and

tongue; and which, though they are inserted into the larynx, have more relation to swallowing, or the motions of the gullet, than to breathing, or to the motions of the windpipe.

The muscles which pull the throat down are these:

XXXIV. The STERNO-HYOIDEUS, which passes from the sternum to the os hyoides; a flat, broad, riband-like muscle, which arises from the upper piece of the sternum, rather within the breast; and partly also from the clavicle and cartilage of the first rib; goes flat and smooth along the fore part of the throat; mounts, nearly of the same breadth, to the os hyoides; and is implanted into its basis, or that part (which in resembling the os hyoides to the jaw) we should compare with the chin.

XXXV. The STERNO-THYROIDEUS, which passes in like manner from the sternum to the thyroid cartilage, is like the last, a flat, smooth, riband-like muscle; rather thicker and more fleshy, but very uniform in its thickness. As the thyroid cartilage is below the os hyoides, the sterno-thyroid muscle must lie under the sterno-hyoideus muscle. It arises under the sterno-hyoideus muscle from the sternum and cartilage of the rib; and is implanted into the rough line of the lower edge of the thyroid cartilage, and a little to one side, but not so much as is represented in Cowper's drawings. It immediately covers the thyroid gland; and the way to the trachea for piercing it in performing bronchotomy is in the middle betwixt these muscles.

XXXVI. The OMO-HYOIDEUS, which was once named CORACO-HYOIDEUS, being thought to arise from the coracoid process. It is a muscle of great length, and very slender, reaching from the shoulder to the os hyoides; it is like these last mentioned, a long, flat, strap-like muscle; as flat and as fleshy, but not so broad, as either of the former. It lies along the side of the neck; is pinched in a little in the middle, where it is divided by a tendinous cross-line, which separates the fleshy belly into two heads. It arises from the upper edge of the scapula, near its notch, and is implanted into the side of the os hyoides, where the horn goes off from the body of the bone.

These three muscles pull the throat down. The sterno-hyoideus and sterno-thyroideus pull it directly downwards: one of the omo-hyoidei acting, pulls it to one side; but if both act, they assist in pulling directly down, and they brace the trachea at the same time a little down to the back.

The muscles which move the throat upward, are:

XXXVII. The MYLO-HYOIDEUS, a flat and broad muscle which arises from the whole semicircle of the lower jaw, *i. e.*

from the backmost grinders to the point of the chin. It rises from the inner surface of the jaw-bone; goes down to the basis of the os hyoides; proceeds with very regular, straight, clear, and orderly fibres, from the jaw to the os hyoides; is plainly divided in the middle from the symphysis of the jaw to the middle of the os hyoides, by a middle tendinous and white line. And though Cowper denies the authority of Vesalius, who divides it thus, it is plainly two distinct muscles, one belonging to either side.

XXXVIII. The GENIO-HYOIDEUS is a small neat pair of muscles arising from the chin at a rough point, which is easily distinguished within the circle of the jaw. The mylo-hyoideus is named from the whole jaw. The genio-hyoideus is named from the chin, arising from a small tubercle behind the chin; its beginning is exceedingly narrow: as it proceeds downwards, it grows flat and broad; it is implanted into the basis of the os hyoides by a broad edge, and is a beautiful and radiated muscle. The sublingual gland lies flat betwixt this muscle and the last; and in the middle the sublingual duct pierces the membrane of the mouth, to open under the root of the tongue. The two muscles move the os hyoides forwards and upwards, when the jaw is fixed; but when the os hyoides is fixed by the muscles coming from the sternum, these muscles of the os hyoides pull the jaw down.

XXXIX. The STYLO-HYOIDEUS is one of three beautiful and slender muscles, which come from round the styloid process; which all begin and end with slender tendons, and with small fleshy bellies; and one going to the pharynx or gullet, another to the os hyoides, and a third to the tongue, they coincide in one common action of drawing back the tongue, and pulling the throat upwards.

This one, the stylo-hyoideus, arises from about the middle of the styloid process, and going obliquely downwards and forwards, is fixed into the side of the os hyoides, where the basis and horn are joined. Above its insertion, its fibres are split, so as to make a neat small loop, through which the tendon of the digastric muscle runs. This stylo-hyoideus is sometimes accompanied with another small fleshy muscle like it, and of the same name; which was first perhaps observed by Cowper, and has been named by Innes STYLO-HYOIDEUS ALTER; but it is not regular, nor has it ever been acknowledged as a distinct muscle.

XL. The DIGRASTICUS, or BIVENTER MAXILLÆ INFERIORIS, is named from its having two bellies. One belly arises from a rugged notch along the root of the mastoid process, where the flesh is thick and strong: going obliquely forwards and down-

wards, it forms a long tendon, round, thick, and very strong, which passes by the side of the os hyoides; and as it passes, it first slips through the loop or noose of the stylo-hyoideus, and then is fixed by a tendinous bridle to the side of the os hyoides; and then turning upwards to the chin, it ends in a second fleshy belly, which, like the first, is flat, and of a pyramidal shape, lying above the mylo-hyoideus.

Though this muscle is often called biventer maxillæ inferioris, as belonging to the lower jaw, perhaps it does more regularly belong to the throat. No doubt, when the os hyoides is fixed by its own muscles from the shoulder and sternum, the digastricus must act on the jaw; an office which we cannot doubt, since we often feel it taking a sudden spasm, pulling down the chin with severe pain and distortion of the neck. But its chief office is to raise the os hyoides; for when the jaw is fixed, as in swallowing, the raising of the os hyoides pulls up the throat; and this is the true meaning of its passing through the noose of the stylo-hyoideus, and of its connexion with the side of the os hyoides. Then the digastric and stylo-hyoideus muscles pull the throat upwards and backwards.

The muscles which move the parts of the larynx upon each other are much smaller, and many of them very minute.

XLI. The HYO-THYROIDEUS goes down, fleshy and short, from the os hyoides, to the thyroid cartilage. It arises from the lower border of the thyroid cartilage, where the sterno-thyroideus terminates, and goes up along the side of the thyroid cartilage, like a continuation of the sterno-thyroideus muscles. It passes the upper border of the thyroid cartilage, and is fixed to the lower edge of the os hyoides, along both its base and part of its horn.

XLII. The CRICO-THYROIDEUS is a very short muscle, passing from the upper edge of the cricoid to the lower margin of the thyroid cartilage, chiefly at its side, and partly attached to its lower horn; which comes down clasping the side of the CRICOID ring, so that it is broader above, and a little pointed below.

These two small muscles must have their use, and they bring the thyroid cartilage nearer to the os hyoides, and the cricoid nearer to the thyroid cartilage; and by thus shortening the trachea, or compressing it slightly, they may perhaps affect the voice. But the muscles on which the voice chiefly depends, are those of the RIMA GLOTTIDIS; for there is a double set of muscles for the little arytenoid cartilages; one set which brings the cartilages together, and another set which draws them apart, and spreads the opening of the larynx.

XLIII. The MUSCULUS ARYTENOIDEUS TRANSVERSUS is

that delicate muscle which contracts the glottis, by drawing the arytenoid cartilages towards each other. It lies across, betwixt them, at their back part; it arises from the whole length of one arytenoid cartilage to go across, and be inserted into the whole length of the opposite one.

XLIV. ARYTENOIDEUS OBLIQUUS, is one which crosses in a more oblique direction, arising at the root of each arytenoid cartilage, and going obliquely upwards to the point of the opposite one. These two muscles draw the arytenoid cartilages together, and close the RIMA.

XLV. The CRICO ARYTENOIDEUS POSTICUS, is a small pyramidal muscle, which arises broader from the back part of the cricoid cartilage, where the ring is broad and deep; and going directly upwards, is implanted with a narrow point into the back of the arytenoid cartilage. This pair of muscles pulls the arytenoid cartilages directly backwards, and lengthens the slit of the glottis.

XLVI. The CRICO ARYTENOIDEUS OBLIQUUS, is one which comes from the sides of the cricoid cartilage, where it lies under the wing of the thyroid, and being implanted into the sides of the arytenoid cartilages, near their roots, must pull these cartilages asunder, and (as the origin in the cricoid lies rather before their insertion in the arytenoid cartilages) it must also slacken the lips of the slit; for the lips of the slit are formed by two cords, which go within the covering membrane, from the tip of each cartilage to the back of the thyroid cartilage; and the crico arytenoideus posticus must strengthen these cords, and the crico arytenoideus lateralis must relax them.

XLVII. The THYREO ARYTENOIDEUS, is a muscle very like the last one, and assists it. It arises not from the cricoid cartilage, but from the back surface of the wing of the thyroid; from the hollow of its wing, or where it covers the cricoid; is implanted into the forepart of the arytenoid cartilage, and by pulling the cartilage forward and sidewise, directly slackens the ligaments and widens the glottis.

These are all the muscles which belong to the larynx; and in our arrangement the muscles of the PALATE and PHARYNX come next in order.

When a morsel is to be thrown down into the œsophagus, or tube which leads to the stomach, the VELUM PALATI, or curtain of the palate, is drawn upwards; the opening of the throat is dilated; the morsel is received; then the curtain of the palate falls down again. The arch of the throat is contracted, the bag of the pharynx is compressed by its own muscles; and the food is forced downwards into the stomach.

XLVIII. The AZYGOS UVULÆ.—The VELUM PENDULUM PALATI, is that pendulous curtain which we see hanging in the back part of the mouth, in a line with the side circles of the throat; and the uvula is a small pap, or point of flesh, in the centre of that curtain. The AZYGOS UVULÆ, or single muscle of the uvula, is a small slip of straight fibres, which goes directly down to the uvula in the centre of the curtain. It arises from the peak, or backmost sharp point of the palate bones, and pulls the uvula, or pap of the throat, directly upwards, removing it out of the way of the morsel which is to pass.

XLIX. LEVATOR PALATI MOLLIS arises from the point of the os petrosum, and from the EUSTACHIAN tube, and also from the sphenoid bone.* These parts hang over the roof of the velum, and are much higher than it; so this muscle descends to the velum, and spreads out in it; and its office is to pull up the velum, to remove it from being in the way of the morsel, which is about to pass, and to lay the curtain back at the same time, so as to be a valve for the nostrils, and for the mouth of the eustachian tube, hindering the food or drink from entering into these passages.

L. The CIRCUMFLEXUS PALATI,† and the CONSTRICTOR ISTHMI FAUSCIUM, have a very different use. The circumflexus palati is named from its fibres passing over, or rather under, the hook of the PTERYGOID process; the muscle arises along with the levator palati (i. e.) from the sphenoid bone at its spinous process; and from the beginning of the eustachian tube, it runs down along the tube, in the hollow betwixt the pterygoid processes; it then becomes tendinous, turns under the hook of the internal pterygoid process, and mounts again to the side of the velum. Now, the levator and circumflexus arise from the same points; but the levator goes directly downwards into the velum, and so is useful in lifting it up. The circumflexus goes round the hook; runs on it as on a pulley; turns upwards again; and so it pulls down the palate, and stretches it: and thence is very commonly named, the TENSOR PALATI MOLLIS, or stretcher of the palate.

* From the eustachian tube, it was named SALPINGO STAPHILINUS; from the sphenoid bone, SPHENO STAPHILINUS; from the pterygoid process, PTERYGO-STAPHILINUS; from the petrous process, it was named PETRO-SALPINGO-STAPHILINUS; as if there were no science but where there were hard names, and as if the chief mark of genius were enriching the hardest names, with all possible combinations and contortions of them.

† This also has got a tolerable assortment of hard names; as CIRCUMFLEXUS PALATI, TENSOR PALATI, PALATO-SALPINGUS, STAPHILINUS EXTERNUS, SPHENO SALPINGO-STAPHILINUS, MUSCULUS, TUBÆ, VIZ. EUSTATIANÆ NONUS. PTERYGO-STAPHILINUS of Cowper, &c.

LI. The CONSTRICTOR ISTHMI FAUSCIUM, arises from the very root of the tongue on each side ; goes round to the middle of the velum, and ends near the uvula.* This semicircle forms that first arch which presents itself upon looking into the mouth.

LII. The PALATO-PHARYNGEUS†, again, forms a second arch behind the first ; for it begins in the middle of the soft palate ; goes round the entry of the fauces, ends in the wing or edge of the thyroid cartilage ; and as the first arched line (that formed by the constrictor) belonged to the root of the tongue, this second arched line belongs to the pharynx or gullet. The circumflexus palati makes the curtain of the palate tense, and pulls it downwards : the constrictor fauscium helps to pull down the curtain, and raises the root of the tongue to meet it : the palato-pharyngeus farther contracts the arch of the fauces, which is almost shut upon the morsel now ready to be forced down into the stomach, by those muscles which compress the pharynx itself.

The PHARYNX, which is the opening of the gullet, that it may receive freely the morsel of food, is expanded into a large and capacious bag, which hangs from the basis of the skull, is chiefly attached to the occipital bone, the pterygoid processes, and the back parts of either jaw-bone. The œsophagus, again, is the tube which conveys the food down into the stomach ; and this bag of the pharynx is the expanded or trumpet-like end of it ; or it may be compared with the mouth of a funnel. Towards the mouth, the pharynx is bounded by the root of the tongue and by the arches of the throat ; behind, it lies flat and smooth along the bodies of the vertebræ ; before, it is protected, and in some degree surrounded, by the great cartilages of the larynx ; the horns of the os hyoides embrace its sides, and it is covered with flat muscular fibres, which, arising from the os hyoides and cartilages of the throat, go round the pharynx, in fair and regular orders, and are named its constrictors, because they embrace it closely, and their contractions force down the food.

LIII. The STYLO-PHARYNGEUS, arises from the root of the styloid process. It is a long, slender, and beautiful muscle ; it expands fleshy upon the side of the pharynx ; extends so far as to take a hold upon the edge of the thyroid cartilage ; it lifts the pharynx up to receive the morsel, and then straitens and com-

* Named GLOSSO-STAPHILINUS, from its origin in the tongue, and insertion into the UVULA.

† The SALPINGO-PHARYNGEUS of Albinus, is no more than that part of the palato-pharyngeus which arises from the mouth of the eustachian tube.

presses the bag to push the morsel down, and by its hold upon the thyroid cartilage, it commands the larynx also, and the whole throat.

The pharynx being surrounded by many irregular points of bone, its circular fibres or constrictors have many irregular origins. The constrictor might fairly enough be explained as one muscle, but the irregular origins split the fibres of the muscle, and give occasion of dividing the constrictor into distinct parts; for one bundle arising from the occipital bone and os petrosum from the tongue, the pterygoid process, and the two jaw bones, is distinguished as one muscle, the constrictor superior.*—Another bundle arising from the os hyoides, is named the constrictor medius.† A third bundle, the lowest of the three, arising from the thyroid and cricoid cartilages, is named the constrictor inferior.‡

LIV. The CONSTRICTOR SUPERIOR, arising from the basis of the skull, from the jaws, from the palate, and from the root of the tongue, surrounds the upper part of the pharynx; and it is not one circular muscle, but two muscles divided in the middle line behind, by a distinct rapha, seam, or meeting of the opposite fibres.

LV. The CONSTRICTOR MEDIUS rises chiefly from the round point in which the os hyoides terminates; it also arises from the cartilage of the os hyoides, *i. e.* where the horns are joined to the body. The tip of the horn being the most prominent point, and the centre of this muscle, it goes upwards and downwards, so as to have something of a lozenge-like shape; it lies over the upper constrictor like a second layer; its uppermost peak or pointed part touches the occipital bone, and its lower point is hidden by the next muscle.

LVI. The CONSTRICTOR INFERIOR arises partly from the thyroid, and partly from the cricoid cartilage; and it again goes also obliquely, so as to overlap or cover the lower part of the constrictor medius. This, like the other two constrictors, meets its fellow in a tendinous middle line; and so the morsel admitted into the pharynx by the dilatation of its arches, is pushed down into the œsophagus by the forces of these constrictores pharyngis, assisted by its styloid muscles.

LVII. The ŒSOPHAGUS is merely the continuation of the

* These good opportunities of names have not been disregarded: this muscle has been named CEPHALO-PHARYNGEUS, PTERIGO-PHARYNGEUS, MYLO-PHARYNGEUS, GLOSSO-PHARYNGEUS.

† This one is named HYO-PHARYNGEUS, or SYNDESMO-PHARYNGEUS, from its origin in the cartilage also of the os hyoides.

‡ This, of course, is named THYRO-PHARYNGEUS, and CRICO-PHARYNGEUS.

same tube. It lies flat upon the back-bone, and it is covered in its whole length by a muscular coat, which is formed, not like this of the pharynx, of circular fibres, but of fibres running according to its length chiefly. And this muscle surrounding the membraneous tube of the œsophagus like a sheath, is named VAGINALIS GULÆ.

MUSCLES OF THE TONGUE.

THE muscles of the tongue are large bundles of flesh which come from the os hyoides, the chin, and the styloid process. Their thickness constitutes the chief bulk of the tongue. Their actions perform all its motions. The muscles, which I am now to describe, form the whole flesh of the tongue, excepting merely the thin membranes which cover the tongue, and give it form, and conduct its nerves to the papillæ or feeling points.

LVIII. The first muscle of the tongue is the STYLO-GLOSSUS, which arises from the styloid process, goes obliquely downwards and forwards; it touches the tongue a little before the angle of the tongue; it makes part of the flesh at the side of the tongue, expanding into its substance in somewhat of a radiated form; its office is to pull the tongue backwards into the mouth.

LIX. The HYO-GLOSSUS is a comprehensive name for all those muscles which arise from the os hyoides. The muscles from the os hyoides go off in three fasciculi, and were once reckoned as distinct muscles. That portion which arises from the basis of the os hyoides, was called BASIO-GLOSSUS; that which arises from the cartilaginous joining of the body and horn, was called CHONDRO-GLOSSUS; and that which arises from the horn itself, was named CERATO-GLOSSUS; or the terms were all bundled together into the perplexed names of BASIO-CHONDRO-CERATO-GLOSSUS.

The hyo-glossus, then, is all that muscular flesh which arises from the whole length of the os hyoides; and which, by the changing form of the bone in its basis, cartilage and horn, has slight marks of division, but which lies all in one plain, and need not have distinct names.

LX. The GENIO-GLOSSUS arises from the rough tubercle behind the symphysis of the chin. It has a very narrow or pointed origin; it spreads out fan-like, as it goes towards the tongue; and it spreads with radii, both forwards and backwards, making the chief part of the substance of the tongue.

LXI. The LINGUALIS is an irregular bundle of fibres which runs according to the length of the tongue: it lies betwixt the

stylo-glossus and the genio-glossus; and as it is in the centre, and unconnected with any bone, it is named lingualis, as arising in the tongue itself.

The genio-glossi muscles form by far the larger part of the tongue, and lie in the very centre. They go through the whole length, *i. e.* from the root to the tip of the tongue; and from the radiated form of their fibres, they perform every possible motion; whence this was named by Winslow, MUSCULUS POLYCHRESTUS, for its rays proceed from one point or centre, and those which go to the point of the tongue pull the tongue backwards into the mouth; those which go backwards, thrust the tongue out of the mouth; the middle fibres acting, make the back of the tongue hollow, while the tip and the root of the tongue both rise.

The hyo-glossi muscles lie on either side of the genio-hyoidæi, and make up the sides of the tongue; and their chief action would seem to be this, that the hyo-glossus muscle of either side acting, the edges of the tongue would be pulled downwards, and the back rounded; the opposite of which motion is the genio-hyoidæi acting, by which the middle of the tongue is made into a groove; the edges rising, and the centre being depressed. Lastly, the stylo-glossus is plainly intended for drawing the tongue deep into the mouth, particularly affecting the point of the tongue.

CHAP. III.

OF THE MUSCLES OF THE ARM.

INCLUDING THE MUSCLES OF THE SCAPULA, ARM, FORE-ARM, AND HAND.

MUSCLES OF THE SCAPULA.

THE great peculiarity of the arm is the manner of its connection with the breast; to which it is fixed by no ligaments, nor joined to no bone, but is at once both fixed and moved by its strong and numerous muscles, which are indeed its only li-

gaments. Though it were perhaps more regular to describe first the muscles of the trunk, it will be more easy and natural to describe first the broad muscles belonging to the scapula, which cover almost the whole trunk, and hide its proper muscles, viz. those which move the ribs and spine. For the muscles which move the scapula lie upon the trunk; those which move the arm lie upon the scapula; those which move the fore-arm lie upon the arm; and those for moving the hand and fingers lie upon the fore-arm. The leg requires but one chief motion, viz. backwards and forwards, flexion and extension: it has no other motions than those of the thigh and of the knee. But the arm requires an easy and circular motion; and its joints are multiplied; for it has the wrist turning round; it has the elbow for hinge-like motions; it has the shoulder-joint, upon which the arm rolls; and to assist all these, the scapula, which is the centre of all these motions, is itself moveable; after a certain point of elevation all the motion in raising the arm is performed, not by the motions of the shoulder-bone upon the scapula, but by the scapula upon the trunk. For whenever the shoulder-bone rises to the horizontal direction, it is checked by the acromion, which hangs over it; and if the arm is to be raised higher still, the scapula must roll; for it turns as if upon an axis passed through it, and in turning it glides upon those muscles, which are like a cushion betwixt it and the trunk.

The muscles which move the scapula come from the breast to move it forwards; from the neck, to move it upwards; from the spines of the vertebræ, to move it backwards; and from the side, that is, from the ribs, to move it downwards.

LXII. The TRAPEZIUS is named from its lozenge form; or is often named CUCULARIS, from its resembling the Monk's cowl; hanging back upon the neck. It is one of the most beautiful muscles in the body; and the two muscles together cover all the shoulders and neck, with a lozenge-like form, with neat and sharp points, extending from the tip of one shoulder to the tip of the other, and from the nape of the neck quite down to the loins. It arises first by a strong tendon from the most pointed part of the occipital bone, and along the transverse spine quite to the mastoid process; from this point all down the neck it has no hold of the vertebræ, but arises from its fellow in a strong tendon, which, extending like a bow-string down the neck, over the arch of the neck, and not touching the vertebræ till it comes down to the top of the back, is named LIGAMENTUM NUCHÆ. The tendon begins again to take hold of the spines of the two last vertebræ of the neck, and arises from all the spinous processes of the back down-

wards; from this long origin, its fibres converge, as it were, into one point, the tip of the shoulder: it also comes a little forward over the side of the neck.

It is implanted into one third of the clavicle nearest the shoulder; into the tip of the acromion; into the whole length of the spine, from which the acromion rises. And its fibres, arising from along the neck and back, and converging almost into a point, must have various effects, according to the different fibres which act: for those which come downwards must raise the scapula; those which come from the middle of the back must carry it directly backwards; those which come from the lower part of the back must depress it; and those different fibres acting in succession, must make the scapula roll. The trapezius is chiefly a muscle of the scapula, but it must be also occasionally a muscle of the head, pulling the head backwards, and bending the neck.

Three other muscles which raise the scapula, or carry it backwards; lie so much in the same plane, and are so little divided from each other, that they might almost be reckoned different portions of the same.

LXIII. LEVATOR SCAPULÆ, named also LEVATOR PROPRIUS ANGULARIS, is a small thin slip of flesh, which arises from the four or five uppermost vertebræ of the neck, at their transverse processes, by three or four, and sometimes five, distinct heads. The heads join to form a thin and flat stripe of muscle, about three inches in breadth, which is fixed by a flat thin tendon to the upper corner of the scapula, to pull it upwards, as in shrugging the shoulders; whence it is named MUSCULUS PATIENTIÆ.

LXIV. and LXV. The RHOMBOID MUSCLE stretches flat, neat, and of a square form, betwixt the spine and the whole line of the base of the scapula. One part arises from the three lower spinous processes of the neck, and is implanted into the base of the scapula at its upper part: then another portion arises from the spinous processes of the first four vertebræ of the back; runs exactly in the same plane with the other into the base of the scapula at its lower part: the part arising from the three vertebræ of the neck is slightly divided from that which arises from the four vertebræ of the back, though not distinctly, and often not at all. I would reckon this but one muscle, but it has been commonly distinguished into (LXIV.) the RHOMBOIDES MINOR, the uppermost portion, and (LXV.) the RHOMBOIDES MAJOR, the lower portion. These are seen after raising the trapezius; and the uses of the trapezius, levator scapulæ, and rhomboides, are to raise the scapula, or to carry it backwards. The muscles which move

the scapula downwards and forwards, viz. the pectoralis minor and the serratus major anticus, lie upon the forepart of the breast.

LXVI. The SERRATUS MAJOR ANTICUS lies upon the side of the chest arising from the ribs; and as the ribs have interstices betwixt them, every muscle arising from the ribs arises by distinct portions from each rib. All such distinct and pointed slips are named digitations, tongues, or serræ, from their resembling the teeth of a saw; and every muscle arising from the ribs must be a serrated muscle. The serratus major anticus is that great and broad muscle, the chief part of which lies under the scapula; and nothing of which is seen but the fleshy tongues, by which it arises from the sides of the ribs. It is all fleshy, and is of a considerable breadth and strength: it arises from all the true ribs, except the first, and from three of the false ribs: its indigitations, of course, spread all over the side of the thorax like a fan: its upper indigitations lie under the pectoralis major, and its lower indigitations are mixed with the beginning of the abdominal muscles: its middle indigitations are seen spreading upon the sides of the thorax: it lies thick and fleshy under the scapula, and is a part of that cushion on which the scapula glides: its fibres converge towards a narrower insertion; and the muscle ends thick and fleshy in the whole length of that line which we call the basis of the scapula, and is, as it were, folded round it: so that this muscle, which comes from before, is implanted along with the rhomboides, which comes from behind.

Perhaps, in difficult breathing, the shoulder blade being raised and fixed by its own muscles, the serratus major may assist in heaving up the ribs: but its chief operation is upon the scapula; for when the whole acts, it pulls the scapula downwards and forwards: when only the lower portions act, it pulls the lower angle of the scapula forwards, by which the scapula rolls, and the tip of the shoulder is raised; when the upper part acts in conjunction with the little pectoral muscle, the tip of the shoulder is fixed and pulled downwards towards the chest, and the lower corner of the scapula rolls backwards.

LXVII. The PECTORALIS MINOR lies under the pectoralis major, close upon the ribs; and as it arises from the third, fourth, and fifth ribs, it also is a serrated muscle, and was named serratus minor anticus: its three digitations are very thick and fleshy; they soon converge so as to form a small, but thick and fleshy muscle, which, terminating in a point, is inserted into the very apex of the coracoid process: by pulling the coracoid process forwards and downwards, it will roll the scapula.

LXVIII. The SUBCLAVIAN MUSCLE is another concealed

muscle of the scapula; for the clavicle is just the hinge upon which the scapula moves, and the subclavian muscle arises by a flat tendon from the cartilage of the first rib: it becomes flat and fleshy, and lies along betwixt the clavicle and the first rib; it arises at a single point of the rib, flat and tendinous; but it is inserted into a great length of the clavicle, beginning about one inch from the sternum, and being inserted all along the clavicle, quite out to where it is joined to the acromion process. Its chief use (since the rib is immoveable) must surely be to pull the clavicle, and consequently the shoulder, downwards, and so to fix them.

Many have affected to find other muscles of respiration than those which directly belong to the ribs. Among these are reckoned the serratus major, the pectoralis minor, &c.; but there is much reason to doubt whether any muscles can have much effect which do not belong properly to the ribs: and it is manifest, that the subclavian can have none, since the first rib is quite rigid, has so little length of cartilage that it cannot bend nor move.

The scapula is thus moved in every possible direction; upwards, by the levator and the trapezius; backwards, by the rhomboides, assisted by other orders of the trapezius; downwards and backwards, by the lowest order of fibres in the trapezius; downwards and forwards, by the serratus major anticus; directly downwards, by the serratus, balanced by the trapezius, and assisted by the subclavius: and directly forwards, by the pectoralis minor.

MUSCLES OF THE ARM.

VIZ. THOSE MOVING THE OS HUMERI, OR ARM BONE.

LXIX. The PECTORALIS MAJOR is a large thick and fleshy muscle which covers all the breast. It arises from two-thirds of the clavicle next the sternum; from all the edges of the sternum; the cartilaginous endings of the fifth and sixth ribs. Where it arises from the sternum, it is tendinous, and the fibres from the opposite muscles cross and mix, so as to make a sort of fascia covering the bone. It is fleshy where it arises from the ribs, and there it mixes with the external abdominal muscle. The fibres approach each other till they form a flat tendon about an inch in breadth; and as the fibres approach each other, they cross in such a way, that the lower edge of the muscle forms the upper edge of the tendon, which is still flat, but twisted: its implantation is into the edge, if I may call it so, of the

groove or rut which is in the shoulder bone for receiving the biceps tendon. That part which arises from the clavicle is a little separated from that which arises from the sternum ; a fatty line makes the distinction ; and they are sometimes described as two parts : it is those two bundles chiefly which cross each other to make the plaited appearance. The pectoralis, among others, has been made a muscle of respiration.*

LXX. The LATISSIMUS DORSI is the broadest, not only of the back, but perhaps of the whole body. It is a beautiful muscle, covering all the lower part of the back and loins, and reaching to the arm, to be the antagonist to the pectoral muscle. It arises by a broad, flat, and glistening tendon, which covers all the loins, and which is in some degree the root of other muscles, especially of the longissimus dorsi. This broad silvery tendon, begins exactly in the middle of the back ; it arises from the lower vertebræ of the loins, from the spines and knobs of the back of the sacrum, and from the back part of the circle of the os ilium : this last is the only part that is fleshy. The flat tendon gradually passes into a flat and regular muscle, which wraps round the side of the body ; and as it lies over the corner of the scapula, it receives a small fleshy bundle from it ; and as it passes over the lower ribs, it has some tendinous slips sent into it, by which it is attached to the ribs. Its fibres converge : for the lower ones ascend ; the upper ones go directly across. And these different orders, not only meet to form its flat tendon, but they cross each other, like those of the pectoral muscle. Here also the tendon is twisted, and the upper edge of the muscle forms the lower edge of the flat tendon ; which passing into the axilla, turns under the arm bone, and is implanted into it, on the inner edge of the bicipital groove. So the tendons of the pectoralis and latissimus meet each other ; they in fact join face to face, as if the one tendon ended directly in the other ; and both united make a sort of lining for the groove, or a tendinous sheath for the long tendon of the biceps to run in.

These two muscles form the axilla or arm-pit ; and although each has its peculiar offices, their chief operation is when they coincide in one action ; and that action is exceedingly powerful, both by the great strength of either muscle, and by their

* Haller tells us, that when at any time, he had rheumatism in this muscle, his breathing was checked ; and when he had difficult breathing, he found great relief by fixing the hands, raising the shoulders, and acting with the pectoral muscles. It seems confirmed by these facts, that asthmatics take this posture ; women in labour fix their arms, by resting upon the arms of their chair ; those who play on wind instruments raise the shoulders in straining, &c.

being implanted into the arm bone four inches below the head. The pectoralis major is for pulling the arm forwards, as in laying the arms across the breast, or in carrying loads in the arms: and it forms the border of the axilla before. The latissimus dorsi has a wider range: when the arm is raised, it brings it downwards, as in striking with a hammer; or downwards and backwards, as in striking with the elbow; or in rolling the arm inwards and backwards, as in turning the palm of the hand behind the back; whence it has the obscene name of MUSCULUS SCALPTOR ANI, or TERSOR ANI; and it forms the back edge of the axilla. The edges of these two muscles receive the pressure of crutches, and defend the vessels and nerves: when both muscles act, the arm is pressed directly downwards, as in rising from our seat, or in holding a bundle under the arm; or when the arm is fixed, these muscles raise the body, as in the example just mentioned of rising from our seat, or in walking with a short stick, or in raising ourselves by our hands over a high beam.

LXXI. The DELTOIDES is the first of those muscles which arise from the scapula to be inserted into the shoulder-bone. It is named deltoid muscle, from its resembling the letter Δ of the Greeks; it is thick and fleshy, and covers the top of the shoulder, filling up the space betwixt the acromion process and the shoulder-bone. It arises from all that part of the clavicle which is not occupied by the pectoralis muscle, and is separated from it only by a fatty line: it arises again in another bundle, from the point of the acromion process; and this middle bundle is also insulated by a fatty line on either side of it: the third bundle arises from the spine of the scapula, behind the acromion process. And thus the muscle has three converging heads, viz. a head from the outer end of the clavicle; a head from the acromion or tip of the shoulder; a head from the ridge of the spine; each divided from the other by a fatty line.* These heads or bundles of fibres, meeting about one third down the humerus, form a short, flat and strong tendon, which grasps, or almost surrounds the shoulder-bone.

These three distinct heads must be observed in speaking of the use of the muscle; for though the chief use of the muscle be to raise the arm, this is not the use of it in all circumstances. For the outer and inner heads, lying by the side of the shoulder-bone, and below the joint, do, when the arm is lying flat by the side, assist the pectoral and latissimus dorsi muscles in draw-

* Albinus has distinguished it into seven fasciculi or bundles; a very superfluous accuracy.

ing it close to the side; but when the middle bundle raises the arm, in proportion as it raises the arm it loses of its power; and in proportion as it loses of its power, the side portions, having come into a new direction, begin to help: nay, when the arm is raised to a certain point, more power still is required, and the clavicular part of the pectoral muscle also comes to assist. It is in this succession that the several bundles of fibres act; for if they began all at once to act, the arm should rather be bound down by the lateral portions than raised by the middle one.

LXXII. CORACO BRACHIALIS.—The coraco brachialis, so named from its origin and insertion, is a long and rather slender muscle.

It arises from the coracoid process of the scapula, along with the short head of the biceps muscle; and it is closely connected with this head almost in its whole length: it is small at its beginning; it grows gradually thicker as it descends; it is all fleshy, and is inserted by a very short tendon into the os humeri, nearly about its middle, betwixt the brachialis and the third head of the triceps. It is perforated by the musculocutaneous nerve. This was observed by Casserius, an Italian anatomist; and the muscle is often named MUSCULUS PERFORATUS CASSERII.

Its action is very simple, to raise the arm obliquely forwards and upwards, and consequently to give a degree of rotation. It will also have a chief effect in pulling the arm towards the side.

LXXIII. The SUPRA SPINATUS, is so named from its occupying the hollow of the scapula above the spine.

It arises from the back of the scapula, from the spine, and from the edge or costa; it is exceedingly thick and fleshy, filling up all the hollow; and it is firmly inclosed in this triangular hollow by a strong tendinous expansion, which passes from the edge of the scapula to the ridge of the spine. It is consequently a muscle of a triangular figure, thick and strong; it passes under the acromion, and degenerates into a tendon there; and going under the acromion as under an arch, and over the ball of the humerus, it adheres to the capsule of the shoulder-joint, and is at last implanted by a broad, strong tendon into the great tuberosity on the head of the bone.

It is evidently designed for raising the humerus directly upwards; and by its attachment to the capsule, the capsule is drawn up when the arm is raised; so that, though lax, it cannot be catched in the joint. It performs exactly the same motion with the middle part of the DELTOIDES, lies in the same direction with it, and assists it.

LXXIV. INFRA SPINATUS, is like the former, in all respects, of the same use, and assists it.

This also is of a triangular shape, and is fully one half larger than the supra spinatus; and as the supra spinatus arises from all the triangular cavity above the spine, this arises from all the triangular cavity below it.

It arises fleshy from all the back of the scapula below the spine itself, and from all the base of the scapula below the beginning of the spine, and also from the lower margin of the scapula. It is very thick and strong, filling up the triangular cavity entirely; and it is closed in like the former by a strong tendinous expansion; it begins to grow tendinous about its middle, but it continues also fleshy till it passes over the socket of the shoulder-joint. It also is connected with the capsular ligament; is inserted into the same tuberosity with the former; and has exactly the same uses, viz. preventing the capsule from being catched in the joint, and raising the arm upwards, and inclining it a little outwards by a slight degree of rotation.—And I do believe that one great use of these two muscles is, when the arm is much extended backwards, to prevent the head of the humerus from starting out of its superficial socket.

LXXV. The TERES MINOR is a third muscle which co-operates with these. This and another are named teres from their appearance, not from their shape; for they seem round when superficially dissected, because then their edges only are seen; but when fully dissected from the other muscles, they are quite flat. The teres minor is a long, small, fleshy muscle; it arises from the angle, and all the lower edge of the scapula: it is like the infra spinatus; it becomes early tendinous, but the tendon is accompanied with fleshy fibres from below; its flat tendon, in passing over the joint, is attached to the capsule, and is finally inserted into the great tuberosity of the shoulder-bone, so that it must have exactly the same uses as the two former muscles. It is separated from the infra spinatus by that tendinous expansion with which the latter is covered; it looks like a part of the same muscle in its origin, where it lies upon the scapula; but is very distinct in its tendon. The supra spinatus, infra spinatus, and teres minor, raise the arm.

LXXVI. The TERES MAJOR, is in shape like the former, lies lower upon the edge of the scapula than the teres minor, and is thicker and longer than it.

It arises chiefly from the angle of the scapula; partly from the lower edge of the scapula at its back part; it is connected with the TERES MINOR and INFRA SPINATUS. It is a large, thick and flat muscle, and forms a flat, strong tendon, which passes under the long head of the triceps. It passes under the os hu-

meri; turns round it, and is inserted into the ridge, on the inner side of the groove, and gives some tendinous fibres to line the groove. In short, it accompanies the tendon of the latissimus dorsi, is inserted along with it, and may be considered as the congener of the latissimus dorsi; and the two tendons are inclosed in one common capsule or sheath of cellular substance.

Its use, then, is evidently to draw the humerus downwards and backwards, and to perform the same rotation of the arms which the latissimus dorsi does.

LXXVII. The SUBSCAPULARIS lines all the concavity of the scapula like a cushion. It is like the surface of the scapula on which it lies, of a triangular shape; and from the convergence of all the fibres, it is completely radiated or fan-like; it is very fleshy, thick and strong. The radii are each minutely described by Albinus; but Sabbattier says, with good sense, that he cannot distinguish them so as to describe them accurately; and he might have added, that there was not the shadow of a motive for wasting time in so trivial an employment as counting the bundles.

It arises from the two edges, the base, and all the internal surface of the scapula. And indeed it is to favour this origin that the inner surface of the scapula is full of little risings and hollows, to every one of which the muscle adheres closely. Just under the coracoid process is the only part from whence it does not arise. That little space is filled up with cellular substance.

Its alternately tendinous and fleshy fibres are so rooted in the scapula, and so attached to its risings and depressions, that it is difficultly cleaned away from the bone.

The tendon and upper edge of the muscle is almost continuous with the supra spinatus: but from the manner of its insertion, its effect is very opposite from that of the supra spinatus; for it goes round the os humeri to its insertion, and it is fixed to the lesser tuberosity; therefore it both pulls the arm backwards and downwards, and performs the rotation like the teres major and latissimus dorsi. It is also like all the other tendons, attached to the capsule, so as to prevent its being catched; and it is particularly useful by strengthening the shoulder-joint.

OF THE MOTIONS OF THE HUMERUS.

HAVING thus described all the muscles which move this bone, I shall review the order in which they are arranged, and mark their places and effects.

To distinguish clearly the function of each muscle, we have but to mark the point to which it is attached.

1. Those implanted above the head of the bone must raise the arm. Now the supra spinatus, infra spinatus, and teres minor, are implanted into the great tubercle, and raise the arm; and the deltoides is implanted in the same direction, and still lower, so that it performs the same action with a still greater degree of power.

2. There is implanted into the opposite, or lower part of the head, the subscapularis, which, of course, draws the arm directly downwards and backwards.

3. There is implanted into the outer edge of the bicipital groove the pectoralis major, and also the coraco-brachialis, which comes in the same direction; and these two pull the arm inwards towards the side, or rather upwards.

4. There are inserted into the inside, or lower side of the groove, the latissimus dorsi and teres major; both of which pull the arm directly backwards. As they bend under the arm, to reach their insertion, they also roll the palm inwards and backwards. And it is easy to observe in what succession those muscles must act, to describe the circular and rotatory motions of the arm.

Joints are more strengthened by the origin and insertion of muscles around them, than by elastic ligaments: for these yield or tear; whereas the muscles, having a living power, re-act against any separating force; they contract, or, in other words, they are strong in proportion to the violence that the joint suffers. Thus, in the shoulder, the capsule is so lax, that there is a mechanical contrivance to prevent its being checked in the joint; and it is moreover so weak, that independent of its yielding easily, it is also very easily torn; but these muscles surround the joint so fairly, that their strength and their tendinous insertions into the head of the bone are more than a compensation for the looseness of its capsular ligament. Were not the muscles thus closely attached, the shoulders would be very often displaced, the glenoid cavity is so superficial, and the bursa so lax: and surely it is for some such purpose that the muscles are planted so closely round the head of the bone; for when they are implanted at a distance from the centre, as one muscle, the deltoid, is, or as the biceps and triceps of the arm, or as the hamstrings, or tendo Achillis are, the power is much increased. Here, in the humerus, power is sacrificed to the firmness of the joint, and they are all implanted closely round the head of the bone.

The joint is in a manner formed by these muscles; for the supra spinatus, infra spinatus, teres major and minor, and the

subscapularis, surround the joint very closely; cover the joint with their flat tendons; and so thicken the capsule, and increase its strength.

MUSCLES OF THE FORE-ARM.

The muscles of the fore-arm are only four; the BICEPS and BRACHIALIS for bending, and the TRICEPS and ANCONÆUS for extending.

LXXVIII. BICEPS BRACHII FLEXOR is universally named BICEPS, from its having two very distinct heads. It is an exceedingly thick and strong muscle; for when it contracts, we feel it almost like a hard firm ball upon the forepart of the arm; and at the upper and most conspicuous part of this ball is the union of the two heads.

The larger and thicker head arises from the coracoid process, by a tendon which extends three inches along the forepart of the muscle, in the form of an aponeurosis; but at the back part the tendon is short, and the muscle is fleshy, and is attached there to the fleshy belly of the coraco-brachialis.

The second, or long head, arises from the edge of the glenoid cavity, at its upper part; it is exceedingly small and tendinous, and this long tendon runs down in its proper cavity, till, about one-third down the arm, the two heads meet. And though below that it is but one fleshy belly, yet there, as in other muscles, the common division betwixt its two origins may be still observed.

It is earlier tendinous at the forepart and outer side; the tendon there sends off that aponeurotic expansion which covers all the fore-arm below, and encloses its muscles as in a sheath. The tendon, at first flat and large, becomes gradually smaller and rounder; it turns a little in its descent, so as to lay one flat edge to the radius, and another to the ulna; and it is at last implanted into that round tubercle which is on the forepart of the radius, a little below its neck.

The great use of the biceps is to bend the fore-arm; which it does with great strength. But as it is inserted into the tubercle of the radius, when the arm and hand are turned downwards, the biceps, by acting, will pull them upwards, i. e. it will assist the supinators. Since both its heads are from the scapula, it will also occasionally move the humerus, as well as the fore-arm.

LXXIX. The BRACHIALIS INTERNUS lies immediately under the biceps, and is a very strong fleshy muscle for assisting the biceps in bending the arm. It is called BRACHIALIS from

its origin in the fore-arm ; and INTERNUS from its being within the biceps, or rather from its being on the inner side of the arm.

It arises from two-thirds of the os humeri at its forepart, by a sort of forked head ; for it comes down from each side of the deltoid. It continues its attachment all the way down the forepart of the humerus to within an inch of the joint. It is very thick, fleshy, and strong ; it is tendinous for about two inches in its forepart ; and is inserted by a flat strong tendon into the coronoid process of the ulna.

Other uses are ascribed to it, as the lifting up the capsule to prevent its being pinched ; but the chief use of it is to bend the fore-arm. In a strong man, it is exceedingly thick, and its edge projects from under the edge of the biceps, and is seen in the lateral view.

LXXX. TRICEPS EXTENSOR.—Upon the back part of the arm three muscles are described : the extensor longus, the extensor brevis, and the brachialis externus ; but it is, in fact, one three-headed muscle.

The longest head of this muscle is in the middle. It arises by a flat tendon of one inch in thickness, from the edge of the scapula under the neck, and a little way from the origin of the long head of the biceps ; and it is under this head that the tendon of the teres major passes to its insertion.

The second head is on the outside of the arm, next in length to this. It arises from the arm-bone under the great tuber, and just below the insertion of the teres minor. These two meet about the middle of the humerus.

The third, or internal head, is the shortest of all. It begins at the inner side of the humerus, just under the insertion of the teres major ; and it arises from the inner part of the humerus, all the way down, and joins just where the second head joins (i. e. about the middle.) All these heads still continue adhering to the humerus (as the brachialis does on the fore side,) quite down to within an inch of the joint ; and then a strong thick tendon is formed, by which it is implanted strongly in the projecting heel of the ulna, named olecranon ; by which projection it has great power, and the power is increased by an increased length in dogs, and other animals which run or bound.

The whole forms a very thick and powerful muscle, which covers and embraces all the back part of the arm ; and its use is too simple to admit of any farther explanation, than just to say that it extends the hinge-joint of the elbow with great power ; and that by its long head it may assist also to bend the shoulder outwards and backwards.

Besides bones, there is also another source of attachment for

muscles, that is, the tendinous expansions: for the expansions, which go on the surface like sheaths, also dive betwixt the muscles, and form septa or partitions, from which their fibres arise.

One tendinous expansion begins from the clavicle and acromion process, or rather comes down from the neck: it is then strengthened by the tendon of the deltoid muscle; it descends, covering all the arm; and before it goes down over the fore-arm, it is again re-inforced chiefly by the biceps, but also by the tendon of the extensor triceps. One remarkable process or partition of this general fascia is sent in from the sheath to be fixed to the outside of the humerus, all the way down to the ridge of the outer condyle. Another partition goes down, in like manner, to the inner condyle, along the ridge which leads to it; then the fascia, taking a firm hold on the condyles, is greatly strengthened about the elbow, and goes over the fore-arm, inclosing its muscles in a very firm and close sheath; and it sends partitions down among the several layers of muscles in the fore-arm, which gives each of them a firm hold.

LXXXI. The ANCONÆUS is a small triangular muscle, placed on the back part of the elbow. It arises from the ridge and from the external condyle of the humerus, by a thick, strong, and short tendon. From this it becomes fleshy; and after running about three inches obliquely backwards, it is inserted by its oblique fleshy fibres into the back part or ridge of the ulna.

It is manifestly designed for the extension of the fore-arm, and has only that one simple action.

MUSCLES OF THE RADIUS, CARPUS, AND FINGERS.

THE whole fore-arm is covered with a mass of muscles of great strength, and so numerous and intricate, with a catalogue of names so difficult, and so distracting, that they should be arranged and classed with much care, explaining to the student the reason and value of their names, and the place and effec of each class.

The fore-arm is covered with a fascia or strong tendinous web, which, like that which covers the temporal muscle, gives both origin and strength to the muscles which lie under it; which divides the several layers one from another; and helps them in their strong actions, with that kind of support which workmen feel in binding their arms with thongs. This fascia is said to proceed from the small tendon of the biceps muscle,

though that were but a slender origin for so great a web of tendon, which not only covers the surface of the muscles, but enters among their layers. This fascia really begins in the shoulder, and has an addition and an increase of strength from every point of bone; it is assisted by each tendon, because the tendons and fascia are of one nature over all the body, and its connection with the tendon of the biceps is quite of another kind from that which has been supposed. I would not allow that the biceps tendon expands into the fascia, but rather that the web receives the biceps tendon, which is implanted into it; and for this wise purpose, that when the fore-arm is to strike, or the hand to grasp, the biceps first moves, and by making the fascia tense, prepares the fore-arm for those violent actions which are to ensue. Thus, it may be defined a web of thin but strong tendon, which covers all the muscles of the fore-arm; makes the surface before dissection firm and smooth; sends down partitions, which are fixed into the ridges of the radius and ulna, enabling those bones to give a broader origin to the muscles, establishing a strong connection among the several layers, and making the dissection always difficult, and never fair nor clean.

The motions to be performed by the muscles which lie upon the fore-arm, are these three; to roll the hand; to bend the wrist; to bend the fingers.

1. The turning of the hand, which is performed by rolling the radius on the ulna, is named pronation and supination.—When we turn the palm down, it is said to be prone; when we turn the palm upwards, it is supine. This is pronation and supination. The muscles which perform these motions are the PRONATORS and the SUPINATORS; and the motion itself is best exemplified in the turning of a key in a lock, or in the guards of fencing, which are formed by a continual play of the radius upon the ulna, carrying the wrist round in circles.

2. The wrist is called the CARPUS, and therefore those muscles which serve for bending or extending the wrist are the FLEXORS and EXTENSORS of the carpus.

3. The bending and extending of the fingers cannot be mistaken; and therefore the flexors and extensors of the fingers need not be explained.

These muscles are denominated from their uses chiefly; but if two muscles perform one motion, they may be distinguished by some accident of their situation or form. And thus, if there be two benders of the fingers, one above the other, they are named FLEXOR SUBLIMIS, and FLEXOR PROFUNDUS, *i. e.* the deep and the superficial flexors. If there be two flexors of the carpus, one is named FLEXOR RADIALIS CARPI, by its running

along the radius; the other FLEXOR ULNARIS CARPI, from passing along in the course of the ulna. And if there be two pronators, one may be distinguished as the PRONATOR TERES, from its round shape, the other as the PRONATOR QUADRATUS, from its square form. And this, I trust, will serve as a key to what is found to be a source of inextricable confusion.

It will be easy to make the origins and insertions of these muscles still more simple than their names; for all the muscles arise from two points, and have but two uses. This assertion shall be afterwards qualified, with a few exceptions; but at present it shall stand for the rule of our demonstration; for all the muscles arise from two points, the external and the internal condyle.

The internal condyle is the longer one, and gives most power; more power is required for bending, grasping and turning the hand; therefore all the muscles which bend the hand, all the muscles which bend the fingers, and the pronator, or that which turns the palm downwards, arise from the internal condyle.

The external condyle is shorter; it gives less power; there is little resistance to the opening of the hand, and little power is required in extending the fingers; and so all the muscles which extend the wrist or the fingers, or roll the hand outwards to turn it supine, arise from the external condyle.

So that when we hear a pronator or a flexor named, we know that the origin must be the internal condyle, and the insertion is expressed by the name: thus a pronator radii is a turner of the radius, and goes to the radius; a flexor carpi goes to the wrist; a flexor digitorum goes to the fingers; and a flexor pollicis goes to the thumb: all the flexors, and all the pronators, issue from that point as from a centre. And again, when a supinator or an extensor is named, we know where to look for it; for they also go out from one common point, the external condyle; and the supinator radii goes to the radius; the extensor carpi goes to the wrist; the extensor pollicis goes to the thumb; and the extensor indicis to the fore-finger.

FLEXORS.

The MUSCLES closing and bending the hand arise from the internal condyle. They are,

The PRONATOR TERES RADII, turning the radius.

PALMARIS LONGUS,
FLEXOR CARPI RADIALIS,
——— ——— ULNARIS,
} bending the wrist.

FLEXOR DIGITORUM SUBLIMIS,
——— ——— PROFUNDUS,
——— LONGUS POLLICIS,
} bending the fingers and thumb.

And, lastly, there is the PRONATOR QUADRATUS, which is the single muscle out of that scheme which I have proposed; lying flat upon the interosseous membrane near the wrist.

LXXXII. The PRONATOR TERES RADII is of the outermost layer of muscles, is small and round; named pronator from its office of turning the radius, and teres from its shape, or rather to distinguish it from the pronator quadratus, which is a short, square muscle, which lies deep again, being laid flat upon the naked bones.

The pronator teres arises chiefly from the internal tubercle of the humerus, at its lower and fore part: it has a second origin from the coronoid process of the ulna. These form two portions, betwixt which passes the radial nerve. The muscle thus formed is conical; is gradually smaller from above downwards; is chiefly fleshy, but is also a little tendinous, both at its origin and at its insertion; and stretches obliquely across the fore-arm, passing over the other muscles to be inserted in the outer ridge of the radius, about the middle of its length.

Its use is to turn the hand downwards, by turning the radius; and it will also, in strong actions, be brought to bend the fore-arm on the arm; or the reverse, when the fore-arm is fixed, and we are to raise the trunk by holding with the hands.

LXXXIII. The PALMARIS LONGUS is a long, thin muscle, which, although it seems to have another use in its expansion into the aponeurosis; yet is truly, by its insertion into the annular ligament of the wrist, a flexor of the wrist, and, in some degree, a pronator of the radius.

It arises from the internal condyle of the os humeri, and is first of five muscles which have one common tendon, and which go out, like radii, from one common centre; viz. the palmaris, the flexor radialis, the flexor ulnaris, the flexor digitorum sublimis, the flexor digitorum profundus.

The palmaris longus arises from the inner condyle of the os humeri, and also from the intermuscular tendon, which joins it with the flexor radialis and flexor digitorum sublimis, and from the internal surface of the common sheath. Its fleshy belly is but two inches and a half or three inches in length; and its long slender tendon descends along the middle of the fore-arm to be inserted into the fore part of the annular ligament of the wrist, just under the root of the thumb. This tendon seems to give rise to the very strong, thick aponeurosis of the palm of the hand, (under which all the muscles of the hand run, and which conceals the arch of blood vessels, and protects them,)

thence the muscle has its name. But it is a very common mistake to think, that because tendons are fixed to the sheaths, the sheaths are only productions of the tendons; whereas the sheaths do truly arise from bones. The fascia, which the deltoides is thought to form, arises from the acromion and clavicle; and the fascia, which the biceps is thought to produce, arises from the condyles of the humerus; and that great sheath of tendon which is made tense by the musculus fascialis of the thigh does not arise from that muscle, but comes down from the spine of the ilium, strengthened by expansions from the oblique muscles of the abdomen. In the present instance, we have the clearest proof of fascia being derived from some other source than the tendons; for sometimes the palmaris muscle is wanting, when still the tendinous expansion is found, and some pretend to say that the expansion is wanting when the muscle is found. The aponeurosis, which covers the palm, is like the palm itself, of a triangular figure; it begins from the small tendon of the palmaris longus, and gradually expands, covering the palm down to the small ends of the metacarpal bones. Its fibres expand in form of rays; and towards the end there are cross bands which hold them together and make them stronger; but it does not cover the two outer metacarpal bones, (the metacarpal of the fore-finger or of the little finger,) or it only covers them with a very thin expansion.

Now this palmar expansion also sends down perpendicular divisions, which take hold on the edges of the metacarpal bones: and thus there being a perpendicular division to each edge of each metacarpal bone, there are eight in all, which form canals for the tendons of the fingers, and for the lumbricales muscles.

LXXXIV. The PALMARIS BREVIS is a thin, flat, cutaneous muscle, which arises properly from the edge of the palmar aponeurosis, near to the ligament of the wrist; whence it stretches across the hand in thin fasciculi of fibres, which are at last inserted into the metacarpal bone, on which the little finger stands, and into the skin and fat on the edge of the palm. This is the PALMARIS CUTANEUS of some authors, for which we can find no use except it were that of drawing in the skin of the hand, and perhaps making the palmar expansion tense.

LXXXV. The FLEXOR CARPI RADIALIS is a long, thin muscle, arising from the inner condyle, stretching along the middle of the fore-arm somewhat in the course of the radius, and is one of the five muscles which rise by one common tendon, and which are, for some length, tied together.

It arises tendinous from the inner condyle; the tendon very

short and thick. This tendon, at its origin, is split into many (seven) heads, which are interlaced with the heads of the sublimis, profundus, palmaris, &c.; consequently this muscle not only arises from the internal condyle, but also from the intermuscular partitions (as from that betwixt it and the sublimis): it forms a long tendon, which, becoming at last very small and round, runs under the annular ligament: it runs in a gutter peculiar to itself; but in this canal it is moveable, not fixed: it then expands a very little, and is inserted into the metacarpal bone of the fore-finger, also touching that which supports the thumb.

Its use is chiefly to bend the wrist upon the radius. But when we consider its oblique direction, it will also be very evident that it must have some effect in pronation; and this, like many of the muscles of the fore-arm, although designed for a different purpose, will also have some effect in bending the fore-arm at the elbow-joint.

LXXXVI. The FLEXOR CARPI ULNARIS is a long muscle, much like the former; but as its course is along the radius or upper edge of the fore-arm, this runs along the ulna or lower edge.

It comes off tendinous from the inner condyle of the os humeri, by the common tendon of all the muscles: it has also, like the pronator teres, a second head (viz. from the olecranon process of the ulna), which arises fleshy; and as the radial nerve passes betwixt the heads of the pronator teres, the ulnar nerve perforates this muscle betwixt its heads. The flexor ulnaris passes all along the flat side of the ulna, betwixt the edge of the sublimis and the ridge of the bone: and here it has a third origin of oblique fibres, which come from the edge of the ulna two-thirds of its length. Its tendon begins early on its upper part, by which it has somewhat the form of a penniform muscle. It has still a fourth origin from the intermuscular partition, which stands betwixt it and the sublimis flexor; and is also attached to the internal surface of the common fascia of the arm. Its long tendon is at last inserted into the os pisiforme at its forepart, where it sends off a thin tendinous expansion to cover and strengthen the annular ligament; and also a thin expansion towards the side of the little finger to cover its muscles.

This is to balance the flexor radialis: acting together, they bend the wrist with great strength; and when this acts alone, it pulls the edge of the hand sidewise.

LXXXVII. The FLEXOR DIGITORUM SUBLIMIS, is named SUBLIMIS from being the more superficial of the two muscles; PERFORATUS, from its tendon being perforated by the tendon

of that which lies immediately below. It lies betwixt the palmaris longus and flexor ulnaris. It is a large fleshy muscle; and not only its tendons, but its belly also, is divided into four fasciculi, corresponding with the fingers which it is to serve.

It arises from the internal condyle, along with the other four muscles; from the ligament of the elbow joint; from the coronoid process of the ulna; and from the upper part of the radius, at the sharp ridge. By these origins it becomes very fleshy and thick; and a little above the middle of the fore-arm divides into four fleshy portions, each of which ends in a slender tendon. The tendons begin at the middle of the fore-arm or near the division; but they continue to be joined to each other by fleshy fibres some way down: and indeed the fleshy fibres cease only when it is about to pass under the annular ligament of the wrist. At this place a cellular stringy tissue connects the tendons with each other, and with the tendons of the profundus; but after they have passed under the ligament, they expand towards the fingers which they are to serve. They each begin to be extended and flattened, and to become thinner; they begin to appear cleft; they pass by the edge of the metacarpal bones, and escape from under the palmar aponeurosis: and where it ends, viz. at the root of the fingers, a tendinous sheath or bursa begins, in which these tendons continue to be inclosed.

The tendons are fairly split just opposite to the top of the first phalanx: and it is at this point that the tendons of the deeper muscle pass through this splitting. The flattened tendon parts into two, and its opposite edges diverge; the back edges meet behind the tendons of the profundus, and form a kind of sheath for them to pass in; and then they proceed forward along the second phalanx, into the forepart of which they are implanted.

This muscle is exceedingly strong. Its chief office is to bend the second joint of the fingers upon the first, and the first upon the metacarpal bone. And in proportion to the number of joints that a muscle passes over, its offices must be more numerous; for this one not only moves the fingers on the metacarpus, but the hand upon the wrist, and even the fore-arm upon the arm.

LXXXVIII. The FLEXOR DIGITORUM PROFUNDUS vel PERFORANS, has the same origin, insertion, and use, insomuch that the description of the last is applicable to this muscle in almost every point. This is of a lower stratum of muscles; it lies deeper, and under the former, whence its name: and by this deeper situation it is excluded from any hold upon the tubercle of the humerus.

It arises from the ulna, along its internal surface ; from the whole surface of the interosseous ligament ; and also in some degree from the intermuscular membrane, which separates this from the sublimis.

This muscle is small, we may say compressed, above ; but it grows pretty strong and fleshy near the middle of the arm ; it divides above the middle of the arm into four portions, corresponding with the four fingers ; and it is about the middle of the arm that the tendons begin, and continue to receive muscular fibres from behind, all down to the ligament of the wrist. At the wrist these tendons are tied to each other, and to the tendons of the sublimis, by loose tendinous and cellular fibres. They diverge from each other, after passing under the annular ligament ; and going along in the hollow of the bones, under the tendons of the sublimis, they first pass through the bridges formed by the palmar aponeurosis, then enter the sheaths of the fingers, and finally pass through the perforations of the sublimis, a little below the second joint of the fingers. At this place the perforating tendons are smaller and rounder for their easy passage ; and after passing they again expand and become flat. They also above this appear themselves split in the middle, without any evident purpose ; they pass the second phalanx, and are fixed into the root of the third. And every thing that is said of the use of the sublimis may be applied to this, only that its tendons go to the furthest joint.

LXXXIX. LUMBRICALES.—I shall here describe, as a natural appendage of the profundus, the LUMBRICALES muscles, which are four small and round muscles, resembling the earth-worm in form and size ; whence they have their name. They arise in the palm of the hand, from the tendons of the profundus, and are therefore under the sublimis, and under the palmar aponeurosis. They are small muscles, with long and very delicate tendons. Their fleshy bellies are about the length of the metacarpal bones, and their small tendons stretch over two joints, to reach the middle of the second phalanx. The first lumbricalis is larger than the second, and the two first larger than the two last.

The first arises from the side of the tendon of the fore-fingers, which is next to the radius ; the others arise in the forks of the tendons ; and though they rise more from that tendon which is next the ulna, yet they have attachments to both. Their tendons begin below the first joint of each finger ; they run very slender along the first phalanx, and they gradually wind around the bone ; so that though the muscles are in the palm of the hand, the tendons are implanted in the back parts of the fingers ; and their final connection is not with the bend-

ing tendons of the sublimis and profundus, but with tendons of the extensor digitorum, and with the tendons of the external interossei muscles, and with which they are united by tendinous threads.

Hence their use is very evident: they bend the first joint, and extend the second; they perform alternately either office: when the extensors act, they assist them by extending the second phalanx or joint: when the flexors act, and keep the first and second joint bended, the extending effect of these smaller muscles is prevented, and all their contraction must be directed so as to affect the first joint only, which they then bend.

They are chiefly useful in performing the quick short motions, and so they are named by Cowper the musculi fidicinales, as chiefly used in playing upon musical instruments.

XC. The FLEXOR LONGUS POLLICIS is placed by the side of the sublimis or perforatus, and lies under the extensor, or rather extensores carpi. It runs along the inner side of the radius, whence chiefly it arises.

Its origin is from all the internal face of the radius downwards; from the place where the biceps is inserted, and from the interosseous ligament, all the length down to the origin of the pronator quadratus, nor does it even stop here; for the tendon continues to receive fleshy slips all the way down to the entry, under the ligament of the wrist. It has often also another head which arises from the condyle of the humerus and the forepart of the ulna; which head is tendinous, and joins near the top of that origin which comes from the radius.

It becomes tendinous very high, i. e. above the middle of the arm; and its small tendon passes under the annular ligament, glides in the hollow of the os metacarpi pollicis, and separates the short flexor into two heads; passes betwixt the two sesamoid bones in the first joint of the thumb, and running in the tendinous sheath, it reaches at last the end of the farthest bone, to be inserted into the very point of it.

There is sometimes sent off from the lower part of the muscle a small fleshy slip, which joins its tendon to the indicator tendon of the sublimis.

Its uses, we conjecture, are exactly as those of the other flexors, to bend the last phalanx on the first, the first on the metacarpal bones, and occasionally the wrist upon the radius and ulna.

XCI. The PRONATOR QUADRATUS, so named from its shape and form, is one of the most simple in its action, since it serves but one direct purpose, viz. turning the radius upon the ulna.

It lies flat upon the interosseous ligament, upon the fore part of the arm, about two inches above the wrist; it is nearly

square, and is about three inches in length and breadth. Its fibres go obliquely across, betwixt the radius and ulna. It arises from the edge of the ulna, adheres to the interosseous ligament, and goes to be implanted into the edge of the radius.—It turns the radius upon the ulna; and this muscle, and in some degree also the flexor pollicis, are the only muscles which do not come fairly under that arrangement by which I have endeavoured to explain the muscles of the fore-arm.

EXTENSORS.

The muscles which lie upon the outer side of the fore-arm, the supinators and the extensors of the fingers and wrist, all arise from one point, the external condyle of the humerus, and are all delivered in this list:

The EXTENSOR CARPI RADIALIS LONGIOR,
The EXTENSOR CARPI RADIALIS BREVIOR,
The EXTENSOR CARPI ULNARIS,
} all extend the wrist.

The SUPINATOR LONGUS,—turns the palm upwards.

The EXTENSOR COMMUNIS DIGITORUM,—extends all the fingers, and unfolds the hand.

The EXTENSOR PRIMI INTERNODII POLLICIS,
The EXTENSOR SECUNDI INTERNODII POLLICIS,
The EXTENSOR TERTII INTERNODII POLLICIS,
} extend the several joints of the thumb.

The EXTENSOR PRIMI DIGITI, vel INDICATOR,—extends the fore-finger.

The EXTENSOR MINIMI DIGITI, vel AURICULARIS,—extends the little finger.

All these muscles arise from one point, the external condyle. They all roll the radius outwards, or extend the wrist, or extend the fingers. As the muscles which bend need more fibres and greater strength, they arise from the internal condyle, which is the larger; they lie in a deep hollow, for the bones of the fore-arm bend to conceal them, and they form a very thick fleshy cushion; but the extensors requiring less power, arise from the shorter process of the outer condyle, are on the convex side of the arm, and are thin, having few fibres: for though there is a large mass of flesh on the inner side of the arm, forming two big flexors, there is only a thin layer on the outer side of the arm, forming one flat and weak extensor.

XCII. SUPINATOR RADII LONGUS. This muscle forms the very edge of the fore-arm: it arises by many short tendinous fibres from the ridge of the humerus, above the external condyle, which origin is fully two inches in length above the con-

dyle. It also arises from the inter-muscular membrane; and, as it stands on the very edge of the fore-arm, it runs betwixt the flexor and extensor radialis. It becomes thicker as it passes the elbow-joint, and there gives a very peculiar form to the arm: it then becomes smaller, and forms a flat tendon, which is quite naked of flesh from the middle of the radius, or a little below, down to the wrist. This tendon becomes gradually smaller till it reaches the wrist, where, expanding a little, it is inserted into the radius, just in the tuber of its lower head.

Its use is perhaps chiefly as a supinator, but it is placed just upon the edge of the arm: it stands as a sort of intermedium betwixt the two sets of muscles; it is fixed indeed rather upon the internal surface of the radius; but yet when the supination is complete, when the hand is rolled very much outward, it will become a pronator.

It is all at once supinator and pronator, and, for a most evident reason, a flexor also of the fore-arm; since its origin is at least two inches up the humerus, above the joint of the elbow.

XCIII. The EXTENSOR CARPI RADIALIS LONGIOR has the additional name of longior or primus, to distinguish it from the next. It is almost entirely covered with the last muscle, the supinator.

It arises from the ridge of the humerus above the external condyle, and just under the origin of the supinator; it descends all along the back of the radius, and after having become a thick fleshy belly, it degenerates a little lower than the middle of the radius into a thin flat tendon, which becomes slender and small as it descends; and turning a little more towards the back of the radius, it then passes over the wrist, and goes along with the tendon of the extensor brevior, under the annular ligament, passing in a groove of the radius; at last it is inserted into the root of the metacarpal bone of the fore-finger, in that edge next the thumb.

It is chiefly an extensor of the wrist: in pronation, it pulls the wrist directly backwards; in supination, it moves the hand sidewise. It is also a pronator when the hand is turned back to the greatest degree; and from its origin, high upon the shoulder-bone, it is also a flexor of the fore-arm.

XCIV. EXTENSOR CARPI RADIALIS BREVIOR. This muscle is almost the same in description, name, and use, with the former. It arises from the external condyle; and here a common tendon for many muscles is formed, just as in the internal condyle; for from this point arise the extensor brevis, extensor digitorum, extensor minimi digiti, extensor carpi ulnaris.

The extensor carpi radialis brevior arises from the outer con-

dyle of the humerus, by the common tendon; it also arises from the aponeurosis, which lies betwixt the extensor digitorum and this; it grows a pretty large fleshy belly, and begins like the last to be tendinous below the middle of the radius; so that this muscle continues fleshy lower than the last one.—Its tendon is also much larger and thicker; it runs under the annular ligament, in the same channel with the extensor longior; it expands a little before its insertion, which is into the fore part of the metacarpal bone of the middle finger, a little towards that edge, which is next to the radius: some little fibres pass from this tendon to the metacarpal bone of the fore-finger.

All that was said concerning the extensor longus may be said of this; for all the three last muscles lie so ambiguously on the edge of the arm, that though they are regularly supinators and extensors, they become pronators and flexors in certain positions of the hand.

XCV. Extensor carpi ulnaris.—By the name merely of this muscle we know its extent and course, its origin, insertion, and use.

It is one of the muscles which belong to the common tendon, arising from the external tubercle of the os humeri: it lies along the ulnar edge of the arm; it arises also from the intermuscular membrane, which separates this from the extensor digitorum and the extensor digiti minimi; and chiefly it is attached to the internal surface of the common sheath. It arises also from the face and edge of the ulna the whole way down; its tendon begins in the middle of its length, and is accompanied all down to the wrist with feather-like fleshy fibres.

It is fixed into the outside of the lower head of the metacarpal bone of the little finger.

Its use is to extend the carpus. And it may be now observed, that when the two extensors of the wrist, the radialis and ulnaris, act, the hand is bent directly backwards; that when the flexor radialis and extensor radialis act together, they bend the thumb towards the radius; and that when the flexor ulnaris and extensor ulnaris act, they bend the little-finger towards the ulna, as in cutting with the edge of the hand: thus a circle may be described by acting with those in succession.

XCVI. Extensor digitorum communis.—This muscle corresponds with the sublimis and profundus, and antagonises them, and resembles them in shape as in use. It covers the middle of the fore-arm at its back, and lies betwixt the extensor radialis secundus and the extensor minimi digiti.

Its origin is chiefly from the outer condyle, by a tendon common to it, with the extensor carpi brevior, and also from the intermuscular membrane, which separates it on one side from

the extensor minimi digiti, and on the other from the extensor carpi brevis, and also from the back part of the common sheath. It grows very fleshy and thick as it descends, and about the middle of the fore-arm it divides itself into three slips of very equal size. But though the tendons begin so high, they continue, like those of the flexors, to receive fleshy penniform fibres all down, almost to the annular ligament. These tendons are tied together by a loose web of fibres; and being gathered together, they pass under the ligament in one common and appropriated channel. Having passed this ligament, they diverge and grow flat and large; and they all have the appearance of being split by a perpendicular line. They are quite different from the flexor tendons in this, that they are all tied to each other by cross bands; for a little above the knuckles, or first joint of the fingers, all the tendons are joined on the back of the hand by slips from the little-finger to the ring, from the ring to the mid-finger, and from that to the fore-finger. So that it seems to be one ligament running quite across the back of the hand. It would be foolish to describe them more minutely; for the cross bands change their places, and vary in every subject, and in some they are not found.

After this the tendons pass over the heads of the metacarpal bones, along the first phalanx of the fingers; and being there joined by the tendons of the interossei and lumbricales, they altogether form a strong tendinous sheath, which surrounds the back of the fingers.

Now, it is to be remembered, that this muscle serves only for the fore, middle, and ring fingers: that if it moves the little finger, it is only by a small slip of tendinous fibres, which it often gives off at the general divergence, but sometimes not; sometimes it gives one slip, sometimes two, often none at all. And so the little finger has its proper extensor quite distinct from this.

The use of this muscle is to extend all the fingers; and when they are fixed, it will assist the extensors of the wrist, as in striking backwards with the knuckles. And since there is but one extensor muscle, the cross tendons are a provision against the bad consequences of any single tendon being cut across.

XCVII. The EXTENSOR MINIMI DIGITI, named also AURICULARIS from its turning up the little finger, as in picking the ear, should really be described with the last muscle. If we see the origin, course, and use of this muscle exactly the same with the common extensor, why should we not reckon it as a slip of the common extensor, appropriated to the little finger?

Its origin is from the outer condyle, along with the other tendons. It also adheres so closely both to the tendinous par-

titions, and to the internal surface of the common fascia, that it is not easily separated in dissection. It begins small, with a conical kind of head; it gradually increases in size; it is pretty thick near the wrist; it adheres all along to the common extensors of the fingers; it begins to be tendinous about an inch above the head of the ulna; it continues to receive fleshy fibres down to the annular ligament; and it passes under the annular ligament in a channel peculiar to itself, which is indeed the best reason for making this a distinct muscle.

This channel has a very oblique direction; and the tendon, like all the others, expands greatly in escaping from the ligament of the wrist. It is connected with the other tendons in the manner I have described. Close to the wrist, it is connected with the tendon of the ring-finger, by a slip which comes from it; and at the knuckle, and below it, it is again connected with the tendons both of the ring-finger and of all the others by the cross bands or expansions.

Whatever has been said of the use of the last muscle is to be understood of this; as its extending its proper finger, assisting the others by its communicating band, and in its extending the wrist when the fist is clenched. Its insertion is into the back of the second joint of the little-finger, along with the interossei and lumbricales. Its tendon has also a small slit; for the head of the proper extensor of the little-finger, and the heads of the common extensors of the others, are inserted into the top of the second phalanx, just under the first joint. They send off at the sides tendinous slips, which, passing along the edges of the bones, do, in conjunction with the tendons of the interossei and lumbricales, form a split tendon, which meets by two curves at the foot of the last bone of the fingers to move the last joint.

XCVIII. The EXTENSOR PRIMUS POLLICIS, is the shortest of the three extensors of the thumb. It is named by Albinus and others ABDUCTOR LONGUS; but since every muscle that extends the thumb must pull it away from the hand, every one of them might be with equal propriety named abductors.

The extensor primus lies just on the fore edge of the radius, crossing it obliquely.

It arises about the middle of the fore-arm, from the edge of the ulna, which gives rise to the interosseous membrane itself, and also from the convex surface of the radius.

The fleshy belly commonly divides itself into two or three, sometimes four fleshy slips, with distinct tendons; which crossing the radius obliquely, slip under the external ligament of the carpus, and are implanted into the root of the first metacarpal bone, or rather of the first phalanx of the thumb, to-

wards the radial edge; so that its chief use is to extend the thumb, and to incline it a little outwards towards the radius. It must also, like the extensors of the fingers, be an extensor of the wrist: and it evidently must, from its oblique direction, assist in supination.

XCIX. The EXTENSOR SECUNDUS POLLICIS is longer than the first. It is named by Douglas the extensor secundi internodii pollicis; by Albinus the extensor minor pollicis.

This muscle lies close by the former. It arises just below it, from the same edge of the radius, and from the same surface of the interosseous membrane; it runs along with it in the same bending course; and, in short, it resembles it so much, that Winslow has reckoned it as part of the same muscle.

Its origin is from the edge of the ulna, the interosseous ligament, and the radius. Its small round tendon passes sometimes in a peculiar channel, sometimes with the extensor primus. It goes over the metacarpal bone of the thumb; it expands upon the bone of the first phalanx; and it is inserted just under the second joint.

It extends the second bone of the thumb upon the first; it extends the first bone also; and it extends the wrist, and by its oblique direction, contributes to supination.

C. EXTENSOR TERTIUS POLLICIS.—This which bends the third joint is called in common the extensor longus pollicis. And here is a third muscle, which, in form, and place, and function, corresponds with the two former ones.

Its origin is from the ridge of the ulna, and from the upper face of the interosseous membrane: and it is a longer muscle than the others; for it begins high, near the top of the ulna, and continues the whole way down that bone, and is very fleshy and thick. It is penniform all the way down to the ligament of the wrist; and its small tendon passes the ligament in a peculiar ring. This tendon appears split, like those of the fingers; it goes along the ulnar side of the first bone of the thumb, reaches the second, and is implanted there by a small slip of tendon; and being expanded, it still goes forward, to be inserted once more into the third bone of the thumb at its root.

Its use is evident after describing the others; for we have only to add another joint for motion. It moves the last joint of the thumb, then the second, then its metacarpal bone upon the carpus; and if that be held firm, it will extend the carpus; and it will, in its turn, contribute to supination, though in a less degree than the others.

CI. INDICATOR.—The EXTENSOR INDICIS PROPRIUS has

very nearly the same origin, and exactly the same course with the last, and lies by the side of it.

Its origin is from the ulna, by the side of the extensor longus pollicis. It has also some little attachments to the interosseous membrane. It, like the others, is feathered with fibres in an oblique direction down to the ligament of the wrist.

This muscle lies under the extensor communis digitorum; its tendon passes along with the common tendon, through the annular ligament; and near the top of the metacarpal bone, or about the place of the common junctions of all these tendons, this one joins with the indicator tendon of the common extensor.

Its use is to extend all the three joints of the fore-finger, assisting the common extensor to point with that finger, to act independently of the common extensor, and to help to extend the wrist when the fingers are closed.

CII. The SUPINATOR BREVIS is an internal muscle, which forms, with the muscles of the thumb, of the fore-finger, and mid-finger, a kind of second layer; and this one lies concealed, much as the pronator quadratus does, on the inner side of the fore-arm. It is a short muscle, but very thick and fleshy, and of great power.

It arises from the outer tubercle of the os humeri, and from the edge of the ulna, and from the interosseous ligament: it is then lapped over the radius, and is inserted into its ridge; so that this supinator brevis is very directly opposed to the pronator teres, the insertion of the two muscles almost meeting on the edge of the radius. It is almost circumscribed to one use, that of performing the rotation of the radius outwards; but perhaps it may also have some little effect in extending the ulna and in assisting the anconeus.

MUSCLES SEATED ON THE HAND.

BESIDES those muscles which bend and extend the fingers, there are other smaller ones seated on the hand itself, which are chiefly for assisting the former, and for quicker motions; but most especially for the lateral motions of the thumb and little-finger; and which are therefore named ADDUCTORS, ABDUCTORS and FLEXORS, of the little-finger and thumb.

That they are chiefly useful in assisting and strengthening the larger muscles, is evident from this, that much power being required for flexion, we find many of these smaller muscles added in the palm of the hand; but as there is little power of extension needed, little more than what will merely balance

the power of the flexors, there are no small muscles on the back of the hand, the interossei externi excepted, which are chiefly useful in spreading the fingers.

The short muscles in the palm of the hand are for bending the thumb, the fore-finger, and the little-finger: and the little-finger and the thumb have each of them three distinct muscles; one to pull the thumb away from the hand, one to bend it, and one to pull it towards the hand, opposing it to the rest of the fingers, and so of the little-finger, which has also three muscles.

ARRANGEMENT OF THESE MUSCLES.

1. LUMBRICALES, which bend all the fingers.
2. ABDUCTOR POLLICIS, FLEXOR AND OPPONENS POLLICIS, ADDUCTOR POLLICIS, bending the thumb and carrying it away from the other fingers, or towards the palm of the hand.
3. ABDUCTOR INDICIS, which carries the fore-finger towards the thumb.
4. ABDUCTOR MINIMI DIGITI, ADDUCTOR MINIMI DIGITI, FLEXOR MINIMI DIGITI, which bend the little-finger, and carry it like the thumb outwards or inwards.
5. INTEROSSEI, which are small muscles, lying betwixt the metacarpal bones, and assisting the lumbricales in bending the fingers.

All the muscles of the thumb are seated on the inside, to form the great ball of the thumb; and it is not easy at first to conceive how muscles, having so much the same place, should perform such opposite motions; yet it is easily explained by the slight variation of their places; for the ABDUCTOR arises from the annular ligament near the radius, and goes towards the back of the thumb. The FLEXOR arises deeper from bones of the carpus, and from the inside of the ligament, and goes to the inside of the thumb. The ABDUCTOR arises from the metacarpal of the mid-finger, and goes to the inner edge of the thumb.

CIII. The ABDUCTOR POLLICIS is covered only by the common integuments. It begins a little tendinous from the outside of the annular ligament, just under the thumb, and by some little fibres from the os scaphoides; and from the tendon of the long abductor or extensor primus, it bends gradually round the thumb, and is at last inserted in the back of the first joint, just above the head of the metacarpal bone. But it does not stop here; for this flat tendon is now expanded into

the form of a fascia, which, surrounding the first bone of the thumb, goes forward upon its back part, quite to the end, along with the common tendon of the extensor. This muscle, like the others, is covered by a thin expansion from the tendon of the palmaris, as well as by the common integuments.

Its only use is to pull the thumb from the fingers, and to extend the second bone upon the first.

Albinus describes a second muscle of the same name, having the same course, origin, insertion, and use: it also arises from the outer side of the ligament of the wrist, and is fixed into the side of the thumb, and lies upon the inside of the former muscle.

These two are inserted into the first bone of the thumb; but the next is inserted into the metacarpal bone.

CIV. The OPPONENS POLLICIS, is often called the metacarpal of the thumb. It is placed on the inside, and implanted into the side of the thumb: its office is to draw the thumb across the other fingers, as in clenching the fist; and from its thus opposing the fingers, it has its name of opponens.

It lies immediately under the last described muscle, and is like it in all but its insertion.

It arises from the os scaphoides, and from the ligament of the wrist. It is inserted into the edge and fore part of the metacarpal bone of the thumb: and its use is to turn the metacarpal bone upon its axis, and to oppose the fingers; or, in other words, to bend the thumb: for I can make no distinction. Therefore this muscle and the next, which lies close upon it, may be fairly considered as but two different heads of one thick short muscle.

CV. The FLEXOR BREVIS POLLICIS is a two-headed muscle, placed quite on the inside of the thumb, betwixt the forefinger and the thumb, and extends obliquely across the two first metacarpal bones. It is divided into two heads by the long flexor of the thumb.

The edge of this muscle lies in close contact with the edge of the last, or opponens; and indeed they may fairly be considered as one large muscle surrounding the basis of the thumb.

One head arises from the os trapezium or base of the thumb, and from the ligament of the wrist. The other head comes from the os magnum, from many of the other bones of the carpus, and from the ligaments which unite them.

The first head is the smaller one; it terminates by a pretty considerable tendon in the first sesamoid bone. The second head runs the same course: it is implanted chiefly in the second sesamoid bone, and also into the edge of the first bone of

the thumb close by it. The second head is exceedingly muscular and strong: the heads are completely separated from each other by the tendon of the flexor longus passing betwixt them.

The office of this muscle is to bend the first joint upon the second, and the metacarpal bone upon the carpus: and indeed the office of this, and of the opponens, is the same. It is in the tendons of this double-headed muscle that the sesamoid bones are found.

CVI. The ADDUCTOR POLLICIS arises from the metacarpal bone of the middle-finger, where it has a flat extended base. It goes from this directly across the metacarpal bone of the fore-finger to meet the thumb. It is of a triangular shape, and flat: its base is at the metacarpal bone; its apex is at the thumb: it is inserted into the lower part or root of the first phalanx: its edge ranges with the edge of the flexor brevis: it concurs with it in office; and its more peculiar use is to draw the thumb towards the fore-finger, as in pinching.

Thus do these muscles, covering the root of the thumb, form that large and convex ball of flesh which acts so strongly in almost every thing we do with the hand. The ball of the thumb is fairly surrounded: it is almost one mass, having one office: but as the deltoides will, in some circumstances, pull the arm downwards, some portions of this fleshy mass pull the thumb outwards obliquely; some directly inwards: but the great mass of muscle bends the thumb, and opposes it to the hand; and as this one muscle is to oppose the whole hand, the ball of flesh is very powerful and thick.

The short muscles of the little-finger surround its root, just as those of the thumb surround its ball.

CVII. The ABDUCTOR MINIMI DIGITI is a thin fleshy muscle, which forms the cushion on the lower edge of the hand, just under the little-finger. It is an external muscle: it arises from the os pisiforme, and from the outer end of the annular ligament. It is inserted laterally into the first bone of the little finger; but a production of it still goes forward to the second bone of the little-finger.

Its use is to spread the little-finger sidewise, and perhaps to assist the flexors.

CVIII. The FLEXOR PARVUS MINIMI DIGITI is a small thin muscle which rises by the side of the last, and runs the same course, with nearly the same insertion.

Its origin is from the ligament of the wrist, and in part from the crooked process of the cuneiform bone. Its use is to bend the little-finger. And indeed the office and place of both is so much the same, that I have marked the last as a flexor; and

the little difference there is, is only that this performs a more direct flexion.

CIX. The ADDUCTOR MINIMI DIGITI is sometimes called the metacarpal of the little-finger. It lies immediately under the former muscle. Its origin is from the hook of the cuneiform bone and the adjoining part of the carpal ligament.

It is inserted into the outside of the metacarpal bone, which it reaches by turning round it. Its use is to put the little-finger antagonist to the others: it is to this finger what the opponens is to the thumb. It also, by thus bending one bone of the metacarpus, affects the whole, increases the hollow and external convexity of the carpus, and forms what is called Diogenes's cup.

CX. The ABDUCTOR INDICIS is a flat muscle of considerable breadth, lying behind the adductor pollicis, and exactly resembling it, being like the second layer. It arises from the os trapezium, and from the first bone of the thumb; and it is inserted into the back part of the first bone of the finger, and pulls the fore-finger towards the thumb.

The interossei are situated betwixt the metacarpal bones. They are small, round, and neat, something like the lumbricales in shape and size. Three are found in the palm, which bend the fingers, and draw their edges a little towards the thumb; four are found on the back of the hand, for extending the fingers.

CXI. The INTEROSSEI INTERNI arise from betwixt the metacarpal bones. They are also attached to the sides of these bones. They send their tendons twisting round the sides to the backs of these bones; and they are inserted along with the tendons of the lumbricales and extensors into the back of the finger. They are thus flexors of the first joint, and extensors of the second joint, as the lumbricales are.

CXII. The INTEROSSEI EXTERNI are four in number. They arise, like the interni, from the metacarpal bones and their interstices, and from the ligaments of the carpal bones. They are peculiar in having each two heads, therefore named interossei bicipites. They join their tendons to those of the extensor and lumbricales: they have therefore one common office with them; that is, extending all the joints of the fingers. Many have chosen to describe the origin and insertion with most particular care, marking the degree of obliquity, and ascertaining precisely their office, and giving particular names to each, as prior indicis for the first external: all which I forbear mentioning, because they must be more liable to perplex than likely to assist the student: if we but remember their common place and office, it is enough. The tendons of the flexor mus-

cles bend round the finger, along with the interossei and lumbricales, for a surer hold; consequently the tendons of the long flexors, of the lumbricales, of the interossei interni, of the extensors, and of the interossei externi, meet upon the backs of the fingers; which are by them covered with a very strong web of tendinous fibres.

CHAP. IV.

MUSCLES OF RESPIRATION; OR, OF THE RIBS.

THE whole back is clothed with strong muscles; and all its holes, irregularities, and spines, are crossed with many smaller ones. These muscles are related either to the arm, to the ribs, or to the spine, i. e. the vertebræ, whose motions they perform; and from this we obtain an arrangement not inconsistent with the regular order of their office, and yet corresponding with the best order of dissection.

The first or uppermost layer of muscles, viz. the trapezius, the musculus patientiæ, the rhomboides, the latissimus dorsi, belong to the arm. The serrated muscles, which lie next under these, are the muscles of respiration, and belong to the ribs: while the splenius and complexus, the muscles of the neck, the longissimus dorsi, sacro lumbalis, and the quadratus lumborum, which are muscles of the back, and the innumerable smaller muscles which lie betwixt the vertebræ, belong entirely to the spine.

Respiration is indeed performed chiefly by the muscles of the belly, that is, in ordinary and easy breathing. In high breathing, the difficulty is relieved by the co-operation of almost all the muscles of the trunk; of which there is scarcely one that may not assist in some slight degree. But yet the muscles of the abdomen have many other offices. And the muscles of the spine, and of the scapulæ, again, belong properly to the arm and trunk; and therefore I call those the muscles of respiration by which the ribs are moved in breathing, and which have no direct relation to almost any other motion but merely that of the ribs.

The muscles which are appropriated to the ribs, performing no other motion, are,

1. The SERRATUS POSTICUS SUPERIOR, which comes from the neck, and lies fleshy over the ribs, to pull them upwards.
2. The SERRATUS INFERIOR POSTICUS, which comes from the lumbar vertebræ, and lies flat on the lower part of the back, to pull the ribs downwards.
3. The LEVATORES COSTARUM, which are twelve flat muscles, arising from the transverse process of each vertebra, and going down to the rib below, they raise the ribs.
4. The INTERCOSTAL MUSCLES, which lie betwixt the ribs, and fill up all the space betwixt rib and rib; they also raise the ribs.

And there may be added to these, that muscle which, lying under the sternum and within the thorax, is called triangularis sterni, and pulls the ribs downwards.

CXIII. The SERRATUS SUPERIOR POSTICUS lies flat upon the side of the neck, under the trapezius and rhomboides, and over the splenius and complexus muscles. It arises by a flat and shining tendon from the spines of the three lower vertebræ of the neck and the two uppermost of the back. It goes obliquely downwards under the upper corner of the scapula, and is inserted into the second, third, and fourth ribs, by three neat fleshy tongues.

The ligamentum nuchæ is chiefly formed by the meeting of the trapezii muscles; and the flat tendons of these upper serrated muscles help to form it.

They are purely levators of the ribs: their effect upon the vertebræ, if they have any, must be very slight.

CXIV. The SERRATUS INFERIOR POSTICUS is a very broad, thin, muscle, situated at the lower part of the back, under the latissimus dorsi, but above the longissimus dorsi muscle.

It arises in common with the latissimus dorsi, from the spines of the two or three lower vertebræ of the back, and the three or four uppermost vertebræ of the loins. Their origin, like that of the latissimus, is by a thin tendinous expansion: it soon becomes fleshy, and, dividing into three, sometimes four, fleshy straps or tongues, each of them is inserted separately into the ninth, tenth, eleventh, and twelfth lower ribs, near their cartilages. So that this muscle, spreading so wide out from the centre of motion, has vast power; for it has the whole length of the rib as a lever.

Its office is to pull the ribs downwards and backwards; the

effect of which must be to compress the chest, and in certain circumstances to turn the spine.

CXV. The LEVATORES COSTARUM are twelve muscles on each side, for the direct purpose of lifting the ribs; they lie above or upon the ribs, at their angles, and are thence named by some SUPRA COSTALES.

They are almost a portion of the external intercostal muscles. The first of the levators arises from the transverse process of the last vertebra of the neck, and goes down to be inserted into the first rib, near its tuberosity; and so all that follow arise from a transverse process, and go to the rib below, being very small and tendinous at either end. But the three last levators arise from the second process above the rib to which they belong. They pass one rib to go into the one below it: they are consequently twice as long as the nine first are; and are therefore named LEVATORES COSTARUM LONGIORES from the ninth downwards.

Thus the levatores costarum are a succession of small muscles, arising from the transverse processes of the vertebræ, and going to the angles of the ribs; beginning from the last vertebra of the neck, and ending with the last but one of the back. They lie under the longissimus dorsi and sacro-lumbalis; and often they have connections with these muscles, sometimes very close.

CXVI. The INTERCOSTALES are two rows of muscles which lie betwixt the ribs: one row is external, the other internal. The EXTERNAL INTERCOSTALS run from the spine towards the sternum, having their fibres directed from behind forwards, and stopping at the cartilages of the ribs. The INTERNAL, again, begin from the sternum, and go towards the spine; they have their fibres directed backwards, and they stop at the angle of the ribs; the reason for which might be given, were it worth our while to stop for an explanation.

These two rows were thought to antagonize each other; the one to pull the ribs downwards, the other to raise them. But I shall not stop to explain this, nor to refute it; it is sufficient to declare their true use, which is (both external and internal) to raise the ribs and assist inspiration.*

The ninth, tenth, eleventh and twelfth ribs, have a freer motion; and it appears to me that this is the true use of the levatores longiores; and for the same reason we find, that from the

* I remember, many years ago, to have heard Dr. Monro explain the office of the intercostal muscles by a diagram, deducing from that argument, the more powerful effect of all muscles having oblique fibres.

sixth rib and downwards there are certain slips of the internal intercostals, which pass over one rib and go to the second below; and as the levatores longiores were called supra-costales, these have been named INFRA-COSTALES, and COSTARUM DEPRESSORES PROPRII. They were discovered by Verhein, and bear his name: they were explained as depressors of the ribs by Haller; but they are little different from the intercostals in form, and not at all in office, for they raise the ribs along with the intercostal muscles.

CXVII. The TRIANGULARIS STERNI, or STERNO COSTALIS, is a depressor of the ribs; an internal muscle lying chiefly on the inner surface of the sternum, and on the cartilages of the ribs. It is very generally considered as a triangular muscle on each side, but some consider it as three or four muscles under the title of sterno-costales.

There are four slips lying on the cartilages of the third, fourth, fifth, and sixth ribs. The lower portion of the triangularis arises from the ensiform cartilage, and is inserted into the third or fourth rib; the third arises from the middle of the sternum, and goes off from the edges of that bone to be inserted into the third rib.

The fourth or uppermost portion is often wanting; it goes off in part also from the inner surface of the sternum, but more commonly from the third rib, and goes to the second rib.

In a dog they are much larger than in a man. Their office is to depress the ribs. And these portions are all conjoined at their roots, which gives the whole muscle the triangular shape.

The true uses of the intercostales, subcostales, and triangularis sterni, have been disputed; but if the first rib be more fixed than the other ribs, then the intercostals proceeding downwards from the first rib must raise all the thorax; and if the sternum be more fixed than the ribs, then the sterno-costales muscles going upwards from the sternum must pull down the ribs.

CHAP. V.

MUSCLES OF THE HEAD, NECK AND TRUNK.

MUSCLES OF THE HEAD AND NECK.

THE serratus superior posticus being raised, the splenii come into view; and the splenii being also lifted, the complexus is fully exposed.

CXVIII. SPLENIUS.—The two splenii are so named from their lying like surgical splints along the side of the neck; both together they have the appearance of the letter Y; the complexus being seen betwixt them in the upper part of the angle. They lie immediately under the trapezii, and above the complexi.

Each splenius is a flat and broad muscle, which arises from the spinous processes of the neck and back, and is implanted into the back part of the head. It arises from the four spines of the back and the five lower of the neck; it parts from its fellow at the fifth vertebra of the neck, so as to show in the interstice two or three of the uppermost spines of the neck, with the upper part of the complexus muscle; each splenius goes obliquely outwards, to be inserted into the occipital ridge, and all along to the root of the mastoid process. At the third vertebra of the neck, where the two splenii muscles part from each other, the tendons of the opposite splenii are closely connected both with each other, and with the common tendon, which is called ligamentum nuchæ.

This is the SPLENIUS CAPITIS; but there is a portion of this same muscle which lies under this, and which has the same common origin, but which terminates by four or five distinct tendons in the transverse processes of the upper vertebra of the neck. This portion may be dissected apart; and has been considered by many as a muscle, the SPLENIUS COLLI of Albinus; who has distinguished as splenius capitis all that part arising from the spines of the neck, and implanted into the head, and as the splenius colli, all that part which arises from the vertebræ of the back, and is implanted into the transverse processes of the neck.

These splenii are the proper antagonists of the mastoid muscles. Both the splenii acting, pull the head directly back-

wards; one acting turns the head and neck obliquely to one side; one acting along with the corresponding mastoid muscle, lays the ear down upon the shoulder.

CXIX. The COMPLEXUS is named from the intricacy of its muscular and tendinous parts, which are mixed; from the irregularity of its origins, which are very wide, it has the names of COMPLEXUS-IMPLICATUS-TRIGEMINUS, by which the student is warned of the difficulty of understanding this muscle.

It lies immediately under the splenius; arises by distinct tendons, with ten or more tendinous feet, from the transverse processes of the neck and back, from the four lower vertebræ of the neck, and from the seven uppermost of the back; having also some less regular origins, as from two spines of the back, and from four oblique processes in the neck. It grows into a large muscle, which is not like the splenius, flat and regular, but thick, fleshy, composed of tendon and flesh mixed; filling up the hollow by the sides of the spines of the neck, and terminating in a broad fleshy head, which is fixed under the ridge of the occipital bone; and this is the part which is seen in the angle or forking of the splenii.

This may stand as the general description of the muscle considered as one: but Albinus has chosen to describe it as two muscles, under two different names, with a minuteness which, far from clearing the demonstration of any difficulties, makes it less distinct; and, if any thing could complete the confusion, it was his humour of calling that BIVENTER which had been hitherto named COMPLEXUS, and naming the lower part of the muscle COMPLEXUS, though it never had been distinguished from the rest.

The BIVENTER of ALBINUS is the upper layer of the muscle, that part which appears in the fork of the splenii: and if we have hitherto named it complexus, from its mixture of tendons and flesh, it is particularly improper to transfer that name to another part of the muscle which is less complicated. This upper layer, the BIVENTER CERVICIS, arises by a large broad head from the occipital bone. In the centre of this belly there is a confusion of tendon; then there is a middle tendon, about the middle of the arch of the neck; and the lower part of the biventer arises from two parts; first, by one slip of flesh from the two uppermost spines of the back; and, secondly, by a larger fleshy portion which comes from the fourth, fifth, sixth, and seventh transverse processes of the back. And it is from the upper and lower fleshy heads, and the confused middle tendon, that it is called biventer.

The COMPLEXUS of ALBINUS lies below this one. It arises by three tendinous and fleshy slips from the three upper trans-

verse processes of the back: then it has four other slips from four oblique or articulating processes of the neck; which various origins are gathered into one thick irregular fleshy belly, which is implanted into the occiput under the great head of the biventer, and mixed with it. This I have chosen to explain, lest the student should be embarrassed by false names; referring him to the first paragraph for the true and simple description of this muscle.

CXX. TRACHELO-MASTOIDEUS*.—The last muscle is often named COMPLEXUS MAJOR, and this COMPLEXUS MINOR; but a fitter name is the TRACHELO-MASTOIDEUS, from its origin in the neck and its insertion in the mastoid process.

It has exactly, or nearly, the same origin and the same insertion with the splenius; for it arises, not from the spines indeed, but from the transverse processes of the back and neck, and is implanted into the mastoid process.

Its origin is from the three first vertebræ of the back, and from the five lowest of the neck at their transverse processes. Its origins are by distinct tendons, and its belly is in some degree mixed of tendon and flesh; whence its name of complexus minor. It is inserted into the mastoid process, just under the insertion of the occipital part of the splenius: and indeed its long and flat belly lies all along under that muscle, so that the order is this: 1. The TRAPEZIUS; 2. The SPLENIUS CAPITIS; 3. The SPLENIUS CERVICIS; 4. The TRACHELO-MASTOIDEUS.

It is needless to speak of its use, since the use of all these muscles is to draw the head backwards directly, when both act; obliquely, when one acts alone.

The RECTI MUSCLES are two deep-seated muscles, which go immediately from the vertebræ to the occiput to be inserted into its lower ridge. They are called major and minor.

CXXI. The RECTUS MINOR is the shorter of the two, arising from the first vertebra of the neck. Its place of origin is a small tuber which stands in the place of the transverse process of the first vertebra; and from that point where it is tendinous, it goes up to the occipital ridge, and is inserted fleshy.

CXXII. The RECTUS MAJOR is larger. It rises, in like manner, tendinous, from the second vertebra of the neck at its transverse process, and mounting from that, is inserted fleshy into the lower ridge of the occiput without the former. These

* It is the TRACHELO-MASTOIDEUS, the MASTOIDEUS LATERALIS, the CAPITIS PARTERTIUS, the COMPLEXUS MINOR: by some it is considered as a part of the COMPLEXUS.

are so placed, that the recti minores appear in the interstice of the recti majores. And though we call them both recti, yet they cannot truly be so; for the recti minores must be, in some degree, oblique, and the recti majores still more so: and consequently, although their chief use be conjointly to draw the head directly backwards, yet one acting must turn the head to its side. And indeed the same may be said of all the muscles of the neck; for they are all divided by the spine, and consequently they are all oblique.

The OBLIQUUS SUPERIOR and OBLIQUUS INFERIOR correspond very closely in all things with the recti; but in their oblique direction the uppermost, as being much shorter, has been named obliquus minor, the lower one obliquus major.

CXXIII. The OBLIQUUS SUPERIOR arises from the transverse process of the atlas, and is inserted into the end of the lower occipital ridge. Its use, notwithstanding its oblique position, is not to turn, but to bend, the head backwards; for the occipital condyles are not concentric circles. Its insertion into the occiput is under the splenius and complexus; but one edge of it is above the insertion of the rectus major.

CXXIV. The OBLIQUUS INFERIOR rises from one vertebra and goes to another. It arises from the spine of the second vertebra: it goes to the transverse process of the first; and it meets the superior oblique muscle; and, by the long lever or arm of the first vertebra, obtains great power. The first vertebra or atlas rolls on the tooth-like process of the dentatus; and while the great and slow motions of the neck in general are performed by other muscles, the short and quick turnings of the head are performed entirely by these oblique muscles.

MUSCLES OF THE TRUNK.

THE great muscles which move the back and loins are the QUADRATUS LUMBORUM, SACRO LUMBALIS, and LONGISSIMUS DORSI.

The sacro lumbalis and longissimus dorsi lie immediately under the latissimus dorsi, which is the outer layer; the quadratus lumborum lies again under these, and next to the abdominal muscles; and, lastly, the abdominal muscles are the innermost layer, and make the back part of the walls of the abdomen. Although the quadratus lumborum lies deep under the longissimus dorsi muscle, I shall describe it first for the sake of a connection which will be presently understood.

CXXV. The QUADRATUS LUMBORUM is a flat squared muscle, named quadratus from its square or rather oblong form.

It arises fleshy from three or four inches of the back part of the os ilium, and from the ligaments of the pelvis, which tie the back part of the ilium to the side of the sacrum and to the transverse processes of the loins. As it goes upwards along the side of the lumbar vertebræ, it takes hold of the points of the transverse processes of each by small tendinous slips; so that we are almost at a loss whether to consider these as new origins or as insertions: but its chief insertion is into the lower edge of the last rib, and a small production of it slips under the arch of the diaphragm, to be implanted into the body or fore part of the last vertebra of the back.

The LONGISSIMUS DORSI and SACRO LUMBALIS have their origin in one common and broad tendon, coming from the sacrum, ilium, and loins; the two muscles lie along side of each other; the longissimus dorsi is nearer the spine, and keeps its tendons closer by the spine. The sacro lumbalis is farther from the spine, and spreads its tendinous feet broader upon the sides of the thorax; and if one be a little under the other, it is the outer edge of the longissimus dorsi, which is a little under the edge of the lumbar muscle.

The common tendon and muscle (for there is for some way but one muscle) begins thus: it may be said to have two kinds of adhesion; for, first, externally it appears a broad, flat, and shining tendon, which arises tendinous from all the spines of the lumbar vertebræ, from the spines of the sacrum, and from the back part of the os ilium. But the inner surface of this broad tendon is strongly fleshy; for it arises fleshy from the back part of the ilium, from the deep hollow betwixt the ilium and sacrum, from the sides of the long spines of the lumbar vertebræ, and from their articulating processes and the roots of their transverse processes. In short, its origin is all tendinous without, and all fleshy within; and its flesh arises from all that irregular surface which is on either side of the spine, betwixt the os ilium and the vertebræ of the loins; and thus it continues one strong tendinous and fleshy muscle, filling up all the hollow of the loins. There is an appearance of separation, something like a split in the tendon, which shows in the loins what part of the tendon belongs to each muscle; but it is only in the back that they are fairly divided.

Just opposite to the lowest rib, the longissimus dorsi and sacro lumbalis break off from the common tendon; and the longissimus goes to be implanted into the vertebræ, and the sacro lumbalis to be implanted into the ribs.

CXXVI. The LONGISSIMUS DORSI is a muscle of the spine. It is not a flat muscle, but round, thick, and firm, filling up all the hollow betwixt the spine and the angle of the ribs. It is of

a long form, as its name implies, terminating towards its top almost in a point. It has two distinct sets of feet by which it is inserted; one set of feet more fleshy, but small and neat, go outwards from the side as it were of the muscle, to be implanted near the heads of the ribs; the lower ones farther out than the heads of the ribs; the upper ones close to the head, and consequently closer to the spine. These heads are nine or ten in number, corresponding with the nine or ten uppermost ribs. Another set of heads, which are not so well seen as this set, because they lie more under the muscle, are small, neat, and tendinous; they go in an opposite direction, viz. inwards and upwards; keep closer by the spine, and are inserted into the transverse processes of the vertebræ of the back. This set of heads is thirteen in number, implanted into the transverse processes of all the back, and of one vertebra of the neck.

CXXVII. The SACRO LUMBALIS separates from the longissimus dorsi at the last rib, and is a flatter and less fleshy muscle: its twelve tendons are flatter than those of the longissimus dorsi, and go out wider from the spine. The tendons next to the longissimus dorsi run highest up, and are the longest; those farthest from the spine, i. e. farthest out upon the chest, are the shortest. It has a flat tendon for each rib, which takes hold upon the lower edge of the rib. But it has another order of small muscles which mix with it: for as the longissimus dorsi has a double row of insertion, this has another set of attachments; for there arises from the surface of each rib, at least of the six or seven lowest ribs, a small slip of flesh, which runs into the substance of the sacro lumbalis, and mixes with it; and these fleshy slips go by the name of the ADDITAMENTUM AD SACRO-LUMBALEM, or MUSCULI ACCESSORII.

Both these muscles, viz. the longissimus and sacro lumbalis, terminate in points which reach towards the neck; and under the point of each there lie the roots of two small muscles, which go up to move the neck. Many have referred these slips going up into the neck entirely to the muscles I am now describing; calling one an ascending slip of the longissimus dorsi, and the other a slip of the sacro lumbalis; while others have described them as distinct muscles, having but slight connections with the longissimus and sacro lumbalis. Their proper names are CERVICALIS DESCENDENS, and TRANSVERSALIS COLLI.

CXXVIII. The CERVICALIS DESCENDENS is connected with the sacro lumbalis muscle; it cannot be entirely referred to it, for the cervicalis descendens arises as a distinct muscle from the five lower vertebræ of the neck at their transverse processes; goes downwards very small and slender to be inserted

into the six uppermost ribs, to get at which it slips under the longest tendons of the sacro lumbalis ; but that the cervicalis descendens does not belong to the sacro lumbalis, may be inferred from its having distinct tendons from six ribs, and from six transverse processes of the neck, and from these tendons being in a direction which does not at all correspond with the heads of the sacro lumbalis. Indeed the longissimus dorsi has a better claim to this muscle ; for a long slip, partly tendinous and partly fleshy, runs upwards from the longest tendon of the longissimus dorsi, to join itself to the cervicalis descendens.*

CXXIX. The TRANSVERSALIS COLLI is that which Sabbatier refers to the longissimus dorsi ; but it is a distinct muscle, arising partly tendinous and partly fleshy from the five upper transverse processes of the back ; lies betwixt the trachelo mastoideus and the cervicalis descendens ; goes from the transverse processes of the back to the transverse processes of the neck, and has no more than a confused and irregular connection with any other muscle.

The QUADRATUS LUMBORUM keeps the trunk erect by the action of both muscles at once ; inclines it to one side, or turns it upon its axis, when one only acts ; and by its insertion into the ribs must assist in high breathing, by pulling down the ribs. The LONGISSIMUS DORSI has no power but over the spine, which it bends backwards, acting continually in keeping the trunk erect. This is also the chief use of the sacro lumbalis ; but the SACRO LUMBALIS going out further upon the ribs, takes such hold upon them, that besides its common action of raising the trunk, it may, on occasions, pull them down, assisting the quadratus and the lower serrated muscle. And it will have greater power in turning the trunk of the body upon its axis than the longissimus dorsi, which pulls almost directly backwards. The CERVICALIS DESCENDENS co-operates with the trachelo mastoideus and others, which turn the head to one side ; and the cervicalis descendens bends the neck to one side ; both the one and the other being independent muscles, and having no further connection with each other than what arises from the confusion of the parts.

* Hence it is plain that the sacro lumbalis and longissimus dorsi have nearly an equal claim to the cervicalis descendens. For, first, the longissimus dorsi sends its longest tendon fairly up into the cervicalis descendens so far, that the slip is implanted, into the transverse processes of the neck. And, secondly, the feet of the cervicalis descendens begin under the last tendons of the sacro lumbalis, so as to have the appearance of arising from its supplementary muscle, the additamentum, and being part of it ; and indeed Sabbatier has described it according to this view.

These two muscles bring us to mention that intricate set of muscles which fills up all the hollows and interstices among the spines and irregular processes of the vertebræ, which might be fairly reckoned as one muscle, since they are one in place and in office; but which the anatomist may separate into an infinite number, with various and perplexing names; and opportunity which anatomists have been careful not to lose.

The surface of the back, from the bulge of the ribs on one side to the bulge of the ribs on the opposite side of the thorax, is one confused surface; consisting of innumerable hollows, processes, and points of bone; and it is tied from point to point with innumerable small muscles, or unequal bundles of mixed tendon and flesh. There are many points; as the spinous, transverse, and oblique processes of the vertebræ, and the bulging heads and angles of the ribs; and each process, or at least each set of processes, has its distinct sets of muscles and tendons.

1. There is one long continuity of muscular and tendinous fibres going from spine to spine, along the whole length of the back and neck. This is divided into the SPINALIS CERVICIS and the SPINALIS DORSI.

2. There is a similar continuation of fibres, with less tendon and more flesh, belonging one half to the spine and the other half to the transverse processes, where it is named SEMI-SPINALIS DORSI.

3. There is a great mass lying all along the hollow of the back, on each side of the spinous processes, which passing alternately from the transverse process of one vertebra to the spinous process of the next above, is of course split into many heads, but yet having such connection as to give it the form and name of a single muscle, the MULTIFIDUS SPINÆ.

4. and 5. There are yet smaller muscular fasciculi, which stand perpendicularly betwixt every two transverse and every two spinous processes; thence they are named INTERTRANSVERSARII and INTER-SPINALES.

CXXX. The SPINALIS CERVICIS is that which is implanted into the spines of the cervical vertebræ; but because it does not go from spine to spine, like the spinalis dorsi, but from transverse processes to spines, it has been named by Winslow SEMI-SPINALIS, or TRANSVERSO-SPINALIS COLLI. It arises from the transverse processes of the six upper vertebræ of the back, and is inserted into all the spinous processes of the vertebræ of the neck except the first and last; and it extends the

neck, or, by its obliquity, may contribute to the turnings of the neck, or to bending it to one side.*

CXXXI. The SPINALIS DORSI arises from two spinous processes of the loins, and from the three lower spines of the back; and passing two spines untouched, it is implanted into all the spines of the back except the uppermost. This muscle is very slender and long, and consists fully more of tendon than of flesh: it has five feet below, rising from the lower spines of the back and loins; and nine feet above, implanted into the upper spines of the back. Its action must raise the spine; but perhaps it may be equally useful as a muscular and tendinous ligament.

CXXXII. The SEMI-SPINALIS DORSI arises from the transverse processes of the lower vertebræ of the back all but two; and is implanted into the upper spinous processes of the back, and into the first spine of the neck†.

CXXXIII. The MULTIFIDUS SPINÆ runs from the sacrum along all the spine to the vertebræ of the neck; and is a comprehensive and true way of describing many irregular portions of flesh, which authors have divided into distinct muscles‡. It is a continued fleshy indentation, from transverse process to spine, through all the vertebræ of the back, neck, and loins.

It begins both tendinous and fleshy from the upper convex surface of the os sacrum, which is rough with spines from the adjoining part of the ilium; and in the loins it arises from oblique processes; in the back, from transverse processes; and again from oblique processes among the cervical vertebræ.

Its origin in the loins is close to the spine; being from the upper oblique processes, and from the root of the transverse processes. In the back it arises from the transverse processes, and therefore arises there by more distinct heads. In the neck, again, it arises from the lower oblique processes more confusedly.

Its bundles or fasciculi are inserted into the spinous processes; sometimes into the second, or even into the third or fourth spine, above that from which the bundle arises; for the tendons do not stop at that spinous process which they first

* The TRANSVERSALIS CERVICIS (vide p. 186.) is that which goes from the transverse processes of the back to the transverse processes of the neck; while this, the SPINALIS CERVICIS, goes from the transverse processes of the back to the spines of the neck.

† This is of course the TRANSVERSO-SPINALIS DORSI of Winslow.

‡ TRANSVERSO-SPINALIS LUMBORUM veterib. SACER; SEMI-SPINALES INTERNUS, five TRANSVERSO-SPINALIS DORSI; SEMI-SPINALIS, five TRANSVERSO-SPINALIS COLLI. pars interna.—Winslow. TRANSVERSALIS LUMBORUM, vulgo SACER; TRANSVERSALIS DORSI; TRANSVERSALIS COLLI.—Douglas.

touch, but go upwards, taking attachments to other two or three, and mixing their tendons with those of the fasciculi above and below; and these tendons reach from the first of the loins to all the vertebræ, up to the atlas, which is the only one not included.

The use of the multifidus spinæ is to retain the spine from being too much bent forwards; for these muscles serve (as I have observed) the purpose of a ligament, and the best of all ligaments, having a degree of strength exactly proportioned to the necessity for strength. It also moves the spine backwards, though perhaps it is less useful in this than as a ligament; for we find it as strong in the vertebræ of the back, which have little motion, and that little very slow and general. It seems rather intended to moderate the lateral motions of the vertebræ than to produce them: when it acts, its chief use is either to resist the spine being bent forward by a weight, or to erect the spine.

CXXXIV. The INTERSPINALES COLLI, DORSI, and LUMBORUM, have varieties so little interesting that they need hardly be described. The INTERSPINALES COLLI are stronger, because the neck has many and quick motions, and the bifurcated spines of the neck give broader surfaces for these muscles. The INTERSPINALES DORSI are almost entirely wanting, because the spines of the back are close upon each other, and the vertebræ are almost fixed. The INTERSPINALES in the LOINS are rather tendons or ligaments than proper muscles.

CXXXV. The INTERTRANSVERSALES are again stronger and fuller in the neck, because of the lateral motions of the neck being free, and its transverse processes forked. They are in more numerous bundles where the motion is greatest, viz. betwixt the atlas and dentatus; and it is there that Albinus counts his INTERTRANSVERSALES CERVICIS, PRIORES-LATERALES, &c. The inter-transversarii are wanting in the BACK, giving place to the ligaments, by which they are tied to each other and to the ribs; but in the LOINS, the inter-transversarii are again strong, for the lateral or twisting motions of the loins.

The muscles on the forepart of the head and neck will complete the catalogue of those belonging to the spine, and they are the chief antagonists to the muscles which I have been describing.

CXXXVI. The PLATISMA-MYOIDES† is a very thin muscu-

† The PLATISMA-MYOIDES is also named MUSCULUS CUTANEUS LATISSIMUS COLLI, and QUADRATUS GENÆ.

lar expansion, like the cutaneous muscle in animals. It is spread over the other muscles immediately under the skin, and covers the whole neck and lower part of the face.

It arises from the cellular substance and aponeurosis, which cover the pectoral muscle, the deltoid muscle, and the clavicle. Its origin is by long separate fleshy slips; it goes like a thin integument over the neck, and is first inserted about the depressor anguli oris; and then going over the masseter, is lost betwixt the muscles and the integuments of the cheek.

Perhaps it serves also to pull down the skin of the cheek and the angle of the mouth; but its chief insertion is into the lower jaw, and its use to pull it downwards.

CXXXVII. MASTOIDEUS.—This muscle arises partly from the clavicle, partly from the sternum. Albinus reckons it two muscles, the STERNO-MASTOIDEUS, and CLEIDO-MASTOIDEUS: a more common name is the STERNO-CLEIDO-MASTOIDEUS: but here, as in other things, I adhere to what is plainest. And the most familiar and easy name is musculus MASTOIDEUS, considering the clavicular portion as an addition only.

Its origin from the upper part of the sternum is pretty round. It arises again flat from the fore part of the clavicle: and this second origin is broad and fleshy, while the first one is tendinous and pointed. These two heads form together a very big strong, bellied, fleshy muscle, which is inserted into the mastoid process by a broad tendon, which indeed surrounds the mastoid process, and from that extends still backwards towards the lamdoidal suture. When one of the mastoid muscles acts, it turns the head to one side; when both act, they pull the head directly forwards.

CXXXVIII. RECTUS INTERNUS CAPITIS MAJOR. There are three muscles on each side, lying under the œsophagus, trachea, and great vessels, flat upon the fore part of the vertebræ; and this is the first and longest.

Although this be called rectus, it is oblique, and runs rather on one side; for it arises from the transverse processes of the five lower vertebræ of the neck, and is inserted into the cuneiform processes of the occipital bone, just before the foramen magnum.

CXXXIX. RECTUS INTERNUS MINOR. This is an exceedingly small muscle; resembles the obliquus posterior of the head. It lies immediately under the RECTUS MAJOR: it arises from the fore part of the body of the first vertebra, the atlas; and going (like the other rectus) obliquely inwards, it is inserted into the occipital bone near the condyle.

CXL. And the RECTUS CAPITIS LATERALIS is another small muscle like the former; which arises from the transverse

processes of the first vertebra, and is inserted into the side of the cuneiform process of the occipital bone. It lies immediately under the exit of the great jugular vein.

CXLI. LONGUS COLLI. This is the chief of those muscles which lie upon the fore part of the neck; it is very long, arising from the flat internal surface of the vertebræ of the back to go up along those of the neck.

Its origin is first within the thorax, from the three uppermost vertebræ of the back, from the flat part of their bodies, and then from all the transverse processes of the neck except the three upper ones. It is inserted tendinous into the fore part of the second vertebra of the neck, where the opposite large muscles meet in one point almost.*

All these muscles, which lie thus flat upon the plain surface of the vertebræ of the neck, pull the head and neck directly forwards; or when the muscles of one side act, they are of use in pulling it towards that side; though I rather suppose that that motion is performed by the external muscles.

CXLII. The SCALENUS I consider as one muscle; for it is one in origin, insertion, and office. Its origin is from the whole upper surface of the first rib from its cartilage backwards, and also from the second rib; and its insertion is into the transverse processes of the vertebræ of the neck. But by its broad origin, and its very long insertion, it gives opportunity for dividing it into several fasciculi; and accordingly it has been so divided: but these divisions are entirely modern, artificial, and unnatural. The ancients considered it as one triangular muscle; Winslow divided it into two, the primus and secundus; Cowper into three; Douglas into four; and Albinus divides it into five muscles. The ancients called it scalenus from its resemblance to the scalen triangle; and the true anatomy is to consider it as one great triangular muscle, flat, and stretching from the ribs to the neck, closing the thorax above, and giving passage to the nerves and vessels of the arm.

If it were to be described in distinct portions, it would be in three parts. The anterior portion arises from the transverse processes of the six lower vertebræ of the neck, and is inserted into the flat part of the first rib hard by its cartilage. The middle portion from the four lower vertebræ goes to the outer edge of the rib, and extends along all its length. The posterior portion is the thinnest and longest; for it arises from the transverse processes of the second, third, and fourth vertebræ. It is inserted into the upper edge of the rib, about an inch or more from its articulation with the spine.

* The longus colli muscle is in part covered by the rectus major.

The first head is tendinous and fleshy at its insertion into the rib; but the second and third heads are tendinous both in their origins and insertions.

The artery goes through the flesh of the first portion, about an inch above the axilla.

The nerves pass in the interstice betwixt the first and second portions.

The office of the scalenus muscle is to pull the neck to one side, or to bend the head and neck forwards when both act; and when the neck is fixed backwards, they may perhaps raise the ribs; for asthmatics are observed to throw the head backwards, in order to raise the chest with greater power.

CHAP. VI.

OF THE MUSCLES OF THE ABDOMEN, AND OF THE DIAPHRAGM.

THE abdominal muscles cover in the belly, contain the bowels, and take a firm hold upon the pelvis and the trunk; the diaphragm, again, is a moving partition betwixt the thorax and the abdomen; and the diaphragm pressing down the bowels upon the abdominal muscles, enlarges the thorax, and the abdominal muscles re-acting, push the bowels back upon the diaphragm, and compress the thorax. Thus the alternate yielding and re-action of the abdominal muscles and diaphragm performs breathing; agitates the bowels; promotes the circulation; expels the fæces and urine; assists the womb in the delivery of the child. And, with all these important uses, the abdominal muscles bend and turn the trunk, and fix it for the stronger actions of the limbs. They steady the body in lifting weights, in bearing loads, in all our more violent exertions: they often give way under this double office of breathing and of straining along with the rest of the body; and the bowels coming out through their natural openings, or by bursting through the interstices of their fibres, form herniæ of various kinds. Whence the anatomy of these muscles is most interesting to the surgeon.

The muscles of the abdomen are five on either side. 1. The outer oblique muscle, to which the names of DESCENDENS, DECLIVIS, and MAJOR, are added, because it is the outermost

of all the abdominal muscles; because it is the largest, covering all the side of the abdomen with its fleshy belly, and all the fore part of the abdomen with its broad expanded tendon; and it is called declivis, or descendens, because its fleshy belly begins above upon the borders of the thorax; and because both its muscular and tendinous fibres, which lie parallel to each other, run obliquely from above downwards and inwards.

2. The OBLIQUUS INTERNUS is named from its being within the first; and has the names of ASCENDENS vel MINOR superadded, because its fleshy belly is smaller than that of the first, arises below, chiefly in the haunch-bone, and all its fibres go from below upwards.

3. The TRANSVERSALIS lies under all the others, and next to the cavity of the abdomen, and has but one name, which also is derived from the direction of its fibres running across or round the abdomen.

4. The RECTUS, so named because of its running on the fore part of the abdomen in one straight line from the pubis to the sternum.

5. The PYRAMIDAL muscle is the only one named from its shape. It is a small, neat, conical muscle, which arises from the os pubis by a broad basis, and has its apex turned upwards; but it is not always found, for it is only as a supplement to the recti muscles and a part of them; whence it has been named MUSCULUS SUCCENTURIATUS, or supplementary muscle.

CXLIII. The EXTERNAL OBLIQUE muscle arises from the ribs, and, like all the others which arise from ribs, is a serrated muscle. It comes from the eight lower ribs by distinct fleshy tongues, one from each rib. These serræ are mixed with the indentations of the serratus major anticus muscle, which goes off in an opposite direction. The origin of the muscle lies out broad upon the border of the chest; it is its thickest and most fleshy part, whence its fibres go down all in one direction parallel with each other, but oblique with respect to the abdomen. Its fleshy belly ceases about the middle of the side. Its flat sheet of tendon goes over the fore part of the belly till it meets its fellow exactly in the middle; so that one half, or the back part of the abdomen, is covered by its fleshy belly, and the fore part by its tendinous expansion.

The muscle meets its fellow in the middle of the belly; and this meeting forms (along with the other tendons) a white line from the pubis to the sternum, which is named LINEA ALBA. It also, before it reaches the middle, adheres to the flat tendon of the inner oblique muscle. This meeting is about four inches on either side of the linea alba, and is a little inclined to the circular, whence it is named linea semilunaris. And,

finally, this muscle is implanted into the spine of the ilium; fleshy about the middle of the ilium; tendinous at the fore part or spinous process of the ilium; and still tendinous into the whole length of that ligament, which extends from the spine of the ilium to the crest of the pubis.

This is the whole of its insertion, viz. all the length of the linea alba, from the pubis to the sternum, the fore part of the spine of the ilium, and the ligament of Paupart; which, though it is commonly thought to be but the tendon of the external oblique stretching from point to point, is in truth a distinct ligament, independent of the tendon, and stronger than it.

CXLIV. OBLIQUUS INTERNUS ABDOMINIS.—The chief part of this muscle arises thick and fleshy from all the circle of the spine of the ilium, with its fibres directed upwards. But, to be accurate, we must describe it as arising from the whole length of the spine of the ilium; from the joining of the ilium and sacrum; from the spines of the sacrum itself; and from the three lower spinous processes of the loins*; and, lastly, it arises from the ligament of the thigh, at its end next to the ilium; but still the chief belly is at the iliac spine. From that it spreads upwards in a radiated form; the central fibres only are direct, going across the abdomen to the linea alba; the higher fibres ascend and go towards the sternum, and the lower ones go obliquely downwards to the pubis. Its flat tendon is like that of the external oblique; and it is inserted into the cartilages of all the false ribs, into the sternum, and into the linea alba through its whole length.

CXLV. The TRANSVERSALIS ABDOMINIS runs directly across the belly. It arises fleshy from the inner surface of the six lower ribs, where its digitations mix with those by which the diaphragm arises tendinous; from the transverse processes of the four lower lumbar vertebræ; from the whole spine of the os ilium; and from a part of the femoral ligament. Upon the whole, its origin is like that of the inner oblique muscle; its fibres go across the abdomen, and its tendon is inserted into the whole length of the linea alba.

The succession in which these three muscles arise from the chest is this: the external oblique muscle lies broad upon the outside of the chest, and so its tongues mix with the tongues of the serratus anticus major. The internal oblique muscle again rises lower down the thorax, from its edge, from the cartilages of the ribs. The transverse muscle arises within the

* This origin from the spinous processes of the loins is a thin tendon common with the serratus and latissimus dorsi muscles.

thorax, from the internal surface of the ribs, opposite to where the tongues of the external oblique lie ; and the diaphragm arising from the same ribs, mixes its indigitations with the transversalis ; so that Caspar Bartholin observing this indigitation to be very curious in the larger animals, believed the diaphragm and transverse muscles to be but one great trigastric or three bellied muscle surrounding all the abdomen.

CXLVI. The RECTI muscles cover the abdomen on its fore part, in a line from the pubis to the sternum; and they belong so equally to the sternum and to the pubis, that it is indifferent which we call their origin, and which their insertion. The origin (as I should call it) of each rectus muscle is in the sternum ; is broad and fleshy ; lies upon the outside of the sternum, covering part of the sternum, and all the xiphoid cartilage, and touching and mixing its fibres with the great pectoral muscle. It is about four inches broad all down the abdomen, and terminates at the side of the symphysis pubis with a flat and pointed tendon about an inch in length and about an inch broad. This muscle is crossed at intervals by four tendinous intersections, which divide it into five distinct bellies. Commonly there are three bellies above the umbilicus and two below ; but the recti muscles are the least regular of all the muscles of the abdomen. Vesalius, Albinus, and Sabbatier, were thought to have found the recti abdominis extending up to the throat ; but it is now found that Vesalius had only represented the muscles of a monkey or of a dog (which are very long) upon the thorax of a human subject*; Sabbatier, upon revising his notes, retracts what he had said; and Albinus also is supposed to have seen only a production of the mastoid muscle, extending down the breast ; for irregularities of this kind are very often found.

CXLVII. The PYRAMIDAL muscles are as a supplement to the recti. There is a small neat pyramidal muscle on each side, or rather a triangular muscle, fleshy through its whole extent and length, with its base turned towards the pubis and its apex towards the umbilicus ; so that its origin is in the crest of the pubis and its pointed insertion in the linea alba : and though the pyramidal muscles have been supposed by Massa

* " Porro (r) linea insignitur, quæ carneam recti musculi partem finit, quæque " ultima ipsius insertionis in homine est portio, uti in quarta tabula ad characterem " n. est cernere. Intercapedine igitur ab r. ad s. pertinente, se offert recti SIMÆ " abdominis musculi tendo, seu membrana, excarnisve musculi pars ; t. autem in- " dicat carneam musculi sedem, primæ costæ et secundæ thoracis insertam. estque " latus ille tendo hominibus haudquaquam, ut in caudatis simiis, et canibus con- " spicuus." VESALIUS, p. 156.

to relate to the penis, or by Fallopius to belong to the urinary bladder, their true use is only to assist the rectus to draw down the sternum, and tighten the linea alba, and so to give greater power to the oblique and transverse muscles. The pyramidalis is so irregular a muscle, that sometimes two are found on one side and none at all on the other. Sometimes two on each side, sometimes there is but one, and very often they are wanting, the belly of the rectus coming quite down to the pubis.

1. The LINEA ALBA is the common meeting of all the thin flat tendons; and therefore we call it their insertion, being the common point towards which they all act: it is white, by the gathering of all the colourless tendons.

2. The LINEA SEMILUNARIS is a line of the same white appearance, of a circular form, and produced by the meeting of all the tendons, on the edge of the rectus muscle, to form a sheath for it.

3. The SHEATH for the RECTUS MUSCLE does not admit of so brief a definition as these: it has been commonly supposed to be formed in a very curious manner, chiefly by the broad tendon of the obliquus internus, which being the central muscle betwixt the two other layers, is supposed to have its tendon split into two thin sheets; that the outermost sheet adheres to the outer oblique muscle, forming the outer part of the sheath, while its inner sheet adheres to the tendon of the transverse muscle, forming the inner part of the sheath: but this is too intricate, and can hardly be proved by dissection. Cowper expresses his doubts about the doctrine of the tendon of the inner oblique muscle being split into two layers; and I think the truest description is this, that all the tendons meet and adhere in the semilunar line; that they immediately part to form this sheath; that the flat tendons of both the oblique muscles go upon the outer surface of the rectus to form that side of the sheath; that the tendon of the transverse muscle only lies under the rectus, forming the lower part of the sheath, and that it is unassisted by any lamella of the inner oblique muscle; that the sheath is complete at the forepart, or over the muscle; but that under the muscle the sheath stops about five or six inches above the pubis, and that there the recti muscles (or in their place the pyramidal muscles) lie bare upon the bladder and other abdominal viscera, lined only by the thin peritonæum*. And that this back layer of the sheath is thinner and

* Cowper had never observed this, but once that the lower part of the rectus was not lined by the tendon of the transversalis. He concluded that, in this instance, it was a sporting of nature; "so much a lusus naturæ, that accidents like this might be the cause of certain ruptures."

more delicate, and but little attached to the back part of the rectus muscle, which is easily raised in dissection; while the forepart of the sheath adheres firmly to the fore part of the muscle forming those cross bands or tendinous intersections which divide the rectus into bellies; and the sheath where it lies over the muscle cannot be dissected without a degree of violence either to the sheath or to these tendinous intersections.

4. The UMBILICUS is that opening in the centre of the abdomen, in the middle of the linea alba, through which the nutritious vessels of the fœtus pass. The vessels have degenerated into ligaments in the adult, and the umbilicus is closed in the form of a ring; but sometimes it is forced by violent action, and the viscera come out by it, forming umbilical hernia.

5. The RING of the ABDOMINAL MUSCLES is that opening near the lower part of the abdomen, just over the pubis, through which the spermatic cord passes in man, and the round ligament of the womb in women.

Cowper (p. 5.) says, that the spermatic cord passes through separate rings, in each of the three abdominal muscles; and, like older authors, he makes nature exceedingly wise, in placing the rings, not opposite to each other, but one high, and another lower, and a third lower still, so as to prevent the bowels falling out. But the truth is, that neither the internal oblique, nor the transverse muscles, have any share, at all in the ring, which belongs entirely to the external oblique muscle, and is formed in this way. All the tendinous fibres of the external oblique are, like the muscle itself, oblique, running from above downwards; and the tendinous fasciculi are in some places wider, a little disjoined from each other, and resembling stripes crossed by small threads of tendon, as if the long fibres were in danger of parting from each other, so as to leave a gap, and were held together by these cross threads; and it is in fact a wider and perfect separation of two fibres that forms the ring, and a strong interlacement of cross fibres that secures it from splitting farther up. But the chief security of the ring is by the form of the opening; for it is not a ring, as we call it, but a mere split in the tendon, which begins about an inch and a half above the pubis, is oblique, and looking towards the pubis, like the fibres which form it, and consists of two legs or pillars of the ring, as they are called; for the upper slip, which forms the upper part of the opening, goes directly towards the crest or highest point of the pubis; the lower pillar, or the slip which forms the lower line of the slit, turns in behind, gets under the upper one, and is implanted into the pubis, within and behind the upper pillar:

this lower slip forms at once the lower pillar of the ring and the edge of the femoral ligament.

Now this crossing of the pillars of the ring secures it; for the more the muscle pulls in pressing upon the abdominal viscera, the tighter is the slit drawn; and the obliquity of the opening gives the direction to herniæ of the groin, which always point towards the pubis, so as to fall into the scrotum in men, or into the labia pudendi in women, keeping close by the groin.

The spermatic cord, formed of the vessels belonging to the testicle, passes through this ring of the external oblique muscle; but as the internal oblique, and transverse muscles, form no share in the ring, the cord passes by their lower edge, but not through it. At the place where the cord passes the edge of the internal oblique muscle, it sends a bundle of fleshy fibres down along the cord, which go all along the cord, gradually extend towards the testicle, expanding and growing thin upon the upper end of the testicle, and gradually disappearing on its body. This is

CXLVIII. The CREMASTER MUSCLE of the TESTICLE, which is a thin slip of fibres from the internal oblique muscle of the abdomen; which is designed for suspending the testicle, and for drawing it up; is very thick and strong in the lower animals, as in bulls, dogs, &c.; is easily found in man, but not always, being sometimes thin and pale, and hardly to be known from the coats upon which it lies. It appears to grow more fleshy in old age, and to be thickened in enlargements of the testicle, the better to support the weight.

6. The LIGAMENT of the THIGH* is a distinct ligament, and not merely the tendon of the external oblique, rounded and turned in. It arises from the spinous process of the ilium, and is inserted into the crest of the pubis. It receives the external oblique muscle, for the tendon is implanted into it. Part of the flesh of the internal oblique muscle arises from the outer end of the ligament. It forms an arch under which the psoas and iliacus internus muscles, and the great artery of the thigh, and its anterior nerve, pass out. The great vein, and the lymphatics of the limb, return under it to get into the abdomen; the lymphatic glands of the groin lie there. The whole interstice is surrounded and filled up by cellular substance and fat; but it is not firm; the playing of the muscles, and the fat, and inguinal glands, keep it open and lax; and at that point the

* This ligament of the thigh is named also the INGUINAL LIGAMENT; the CRURAL ARCH: the LIGAMENT of PAUPART; the LIGAMENT of FALLOPIUS, &c.

bowels are apt to fall down, especially in women, where the spine of the ilium is high and the arch wide. So little are femoral herniæ or the form of this opening understood, that no particular cushion is adapted to this part; for it is supported by the common bandage for the hernia of the groin: and, a few years ago, hernia of the groin was not even known by anatomists of the highest name. For Cowper says (explaining Paupart's ligament,) "It is not impossible but that ruptures "may sometimes happen in this part; and I am apt to imagine "this to be the case when a rupture is very large, and not to be "retained by a truss."

It often happens, that in vomiting, in violent coughing, in straining at stool, or in lifting heavy weights, these natural openings are forced, and the bowels descend. The UMBILICUS is very seldom forced by sudden exertion, for it is a very firm ring; but often it is slowly dilated in pregnancy; and hernia of the naval is infinitely more frequent with women than with men.—The opening of the RING is often kept dilated by the bowels following the testicle when it descends; so that though the accident be almost forgotten, the hernia often appears again in the adult: most frequently the ring is forced in strong young men by hard and continual labour, or by sudden straining; but women are safer from this kind of hernia, because the round ligament of the womb is smaller than the spermatic cord, and the ring in them is very close.—ABDOMINAL HERNIÆ are those which come, not through any natural opening, but through the interstices of the muscles, by the parting of the muscular fibres on an accidental wound in the abdomen, or by the operation of the Cesarean section; for a wound of the abdominal muscles seldom heals so neatly as not to leave some small interstice, through which the bowels protrude. Thus any point may be forced by violence, any of the openings, or all of them, may be relaxed by weakness, as in dropsical or other lingering diseases: for it is from this cause that herniæ are more frequent in childhood and in old age; by the laxity which is natural to childhood, or by the weakness natural to the decline of life. Often there seems to be a hereditary disposition to herniæ in certain houses; the form of the openings of the abdomen being wider in a whole family, just as the features of the face are peculiar. And I have seen a child with all these openings so particularly wide, that upon the slightest coughing or crying, herniæ came down at every possible point, at the navel, the scrotum, the thigh, and in the sides of the abdomen, all at once; or, as one tumour was reduced, another arose.

The effects of the abdominal muscles in moving the trunk cannot be mistaken. The RECTI pull the ribs downwards in

breathing, flattening the belly, and bending the body forwards. The two OBLIQUE MUSCLES of one side acting, turn the trunk upon its axis; but the oblique muscles of the opposite side acting, co-operate with the rectus in flattening the belly and bending the body: and the TRANSVERSE MUSCLES tighten the linea alba, so as to give effect to all the others; and particularly they brace the sheath of the recti muscles, so as to give them their true effect.

CXLIX. The DIAPHRAGMA is a Greek word, translated inter septum; the transverse partition betwixt the abdomen and the thorax; the midriff: but it is not merely a transverse partition, it is a vaulted division betwixt the thorax and abdomen; and not only is the middle raised into a vaulted form, but its obliquity is such, that though its fore part be as high as the sternum, its lower and back part arises near the pelvis from the lowest vertebræ of the loins.

It is a circular muscle, which is fleshy towards its borders, and tendinous in the centre; which is convex towards the thorax, and concave towards the abdomen; becoming plain, or almost so, when it presses against the abdominal muscles in drawing the breath; and returning to its convex form when the abdominal muscles re-act in pushing it back into the thorax.

The diaphragm arises, by one broad fleshy attachment, from all the borders of the chest, forming the upper or greater muscle of the diaphragm; and it arises below, by many small tendinous feet, from the fore part of the loins, which, meeting, form what is called the lesser muscle of the diaphragm. 1st. The GREAT or UPPER muscle arises, first, from under the xiphoid cartilage, and from the lower surface of the sternum.—2dly. From all the false ribs; from the cartilage of the seventh, eighth, and ninth ribs; and from the bony parts of the tenth and eleventh ribs; and from the tip of the twelfth rib. All these origins are, of course, fleshy digitations or tongues, which intermix with those of the transverse muscle of the abdomen. 3dly. From the tip of the twelfth rib to the lumbar vertebræ there is a ligament extended, which, going like an arch over the psoas and quadratus lumborum muscles, is named LIGAMENTUM ARCUATUM; and from this another part still of the great muscle of the diaphragm arises. Thus the upper muscle of the diaphragm has four chief origins, viz. from under the sternum and xiphoid cartilage; from all the false ribs; from the ligamentum arcuatum: and, in short, from all the borders of the chest, from the xiphoid cartilage quite round to the vertebræ of the loins.

2. The LESSER MUSCLE of the DIAPHRAGM, which arises from the spine, begins by four small slender tendinous feet on

each side. The first of these, the longest one, arises from the second vertebra above the pelvis : it goes from the flat fore part of its body, and adheres to the fore part of all the lumbar vertebræ as it mounts upwards. The second rises from the third vertebra, but farther out towards the side of the vertebra. The third arises from the side of the fourth vertebra. And the fourth tendon of the diaphragm arises from the transverse process of the same fourth vertebra of the loins. But indeed we ought, in place of this minute demonstration, to say, that it arises from the four uppermost lumbar vertebræ by four tendinous feet, flat and glistening, and adhering closely to the shining ligament with which the bodies of the vertebræ are strengthened; that these tendons soon join to form a strong round fleshy leg, which is called the crus diaphragmatis ; of which crura the left is the smaller one ; and that these crura, joining, mixing, and crossing their fibres, form a fleshy belly, the lesser muscle of the diaphragm.

3. The TENDON in the centre of the diaphragm is determined in its shape by the extent of these fleshy bellies ; for the great muscle above almost surrounds the central tendon. The smaller muscle below meeting it, the two divisions give it a pointed form behind ; the tendon has the figure of a trefoil leaf, or of the heart painted upon playing cards. The middle line of this tendinous centre is fixed by the membrane which divides the thorax into two ; the two sides go upwards into the two sides of the chest, each with a form like the bottom of an inverted basin ; their convexity reaching within the thorax, quite up to the level of the fourth true rib : the proper centre of the diaphragm is fixed by this connection with the mediastinum, that its motion might not disorder the action of the heart, which rests upon this point, and whose pericardium is fixed to the tendon : but the convexity of either side descends and ascends alternately as the diaphragm contracts or is relaxed ; so that it is chiefly these convexities on either side which are moved in breathing.

Thus is the diaphragm composed of one great and circular muscle before ; of one smaller circular muscle behind ; and of the triangular tendon, as the centre betwixt them ; and both in its fleshy and tendinous parts, it is perforated by several vessels passing reciprocally betwixt the thorax and the abdomen.

First, The AORTA or great artery of the trunk passes betwixt the crura or legs of the diaphragm, which like an arch stride over it to defend it from pressure.

Secondly, The ŒSOPHAGUS passes through the diaphragm a little above this, and to the left side : its passage is through

the lower fleshy belly, and through the most fleshy part of the diaphragm : and the muscular fibres of the crura diaphragmatis first cross under the hole for the œsophagus, then surround it, then cross again above the hole; so that they form the figure of 8 : and the œsophagus is so apparently compressed by these surrounding fibres, that some anatomists have reckoned this a sort of sphincter for the upper orifice of the stomach.

Thirdly, The great VENA CAVA goes up from the abdomen to the heart, through the right side of the diaphragm ; and this hole being of a triangular form, being in the hard tendon, and larger than the vein requires, there is no danger of strangulation in the vein.

The tendon is composed of fibres which come from the various fasciculi of this muscle, meet and cross each other with a confused interlacement, which Albinus has been at much pains to trace, but which Haller reports much more sensibly : "Intricationes variæ et vix dicendæ ;" irregular and confused, crossing chiefly at the openings, and especially at the vena cava, the triangular form of which seems to be guarded in a most particular way.

The lower surface of the diaphragm is lined with the peritonæum or membrane of the abdomen ; and the upper surface is covered with the pleura or membrane of the chest. The hole for the vena cava is so large that the peritonæum and pleura meet, and touch each other through this opening all round the vein.

The chief use of the diaphragm is in breathing ; and in this office it is so perfect, that though there be a complete anchylosis of the ribs (as has often happened,) the person lives and breathes, and never feels the loss. The diaphragm is, in its natural state, convex towards the thorax ; when it acts, it becomes plain, the thorax is enlarged, and by the mere weight of the air the lungs are unfolded and follow the diaphragm. No vacuum is ever found betwixt the diaphragm and the lungs ; but the lungs follow the ribs and diaphragm as closely as if they adhered to them ; and indeed when they do adhere, it is not known by any distress ; so we draw in the breath : and when the abdominal muscles re-act, the diaphragm yields, goes back into the thorax, and grows convex again, by which we blow out the breath ; and while the diaphragm is acting, the abdominal muscles are relaxed, yield, and are pushed out, and leave the ribs free to be raised by their levator muscles. And again, when the abdominal muscles re-act, the diaphragm in its turn yields so that they at once force up the diaphragm, and pull down the borders of the thorax, assisting the serrated muscles which depress the ribs.

There is also in every great function such a wonderful combination of actions conspiring to one end, as cannot be even enumerated here. But the alternate action and re-action of the abdominal muscles draws in and expels the breath, promotes the circulation, and gently agitates the bowels, while their more violent actions discharge the fæces and urine, and assist the womb; and vomiting, yawning, coughing, laughing, crying, hiccup, and the rest, are its stronger and irregular actions.—The diaphragm might well be named by Haller, "Nobilissimus, post cor, musculus." And Buffon, who affected the character of anatomist with but little knowledge of the human body, might mistake its central tendon for a nervous centre, the place of all motions, and almost the seat of the soul. For the ancients confounded the names and ideas of tendon and nerve. And in sickness and oppression, lowness and sighing, in weeping or laughing, in joy or in fear, all our feelings seem to concentrate in this part.

CHAP. VII.

THE MUSCLES OF THE PARTS OF GENERATION, AND OF THE ANUS AND PERINÆUM.

THE muscles of the parts of generation follow this division of the abdominal muscles more naturally than any other.

The ERECTOR PENIS is a small and slender muscle, which goes over the crus penis, and braces it back to the pubis. The erectores are supposed (by pressing the penis against the pubis) to compress the great vein, and so cause erection. The ACCELERATOR URINÆ is a muscle which surrounds all the bulb of the urethra, and acts by a sort of subsultus in discharging the last drops of the urine, and in throwing out the semen. And the TRANSVERSALIS PERINÆI, which goes across the perinæum, belongs rather to the anus than to the penis. The SPHINCTER ANI is a circular bundle of fibres which surrounds the orifice of the anus, and contracts it; and the LEVATOR ANI is a flat thin muscle, which lines the pelvis, surrounds the rectum like a funnel, and being fixed round the margin of the anus, raises it up; and the COCCYGÆUS is but a part of it. The DETRUSOR URI-

NÆ is the muscular coat of the bladder and the SPHINCTER VESICÆ is not easily distinguished from the detrusor urinæ, being but the fibres of it, only thicker and stronger at the lower and narrower part of the bladder.

The penis is composed of two crura or cavernous bodies, which arise from the branch of each os ischium, which soon meet to form the body of the penis; and of the corpus cavernosum urethræ, which surrounds the urethra, is attached to no bone, but begins just before the circle of the anus, by a bulging which is called the bulb of the urethra; and the erector penis lies along the crura, to draw them back to the pubes; and the accelerator surrounds all the bulb, and acts in expelling the semen or the last drops of urine.

CL. The ERECTOR PENIS is a delicate and slender muscle, about two inches in length. It lies along the face of the crus penis of each side. And when the crura penis are inflated, the erectors are seen of their proper length and form. The erector of each side rises by a slender tendon from the tuberosity of the os ischium. It goes fleshy, thin, and flat, over the crus penis, like a thin covering. It ends in a delicate and flat tendon upon the crus penis, about two inches up; and the tendon is so thin and delicate, that it is hardly to be distinguished from the membrane of the cavernous body.

The erectors lying thus on the sides of the penis, have been called COLATERALES PENIS, or ISCHIO-CAVERNOSI, from their origin in the ischium, and their insertion into the cavernous bodies.

CLI. The TRANSVERSALIS PERINÆI is often named transversalis penis; but its origin being in the tuberosity of the os ischium, by a delicate tendon, and its insertion into the very backmost point of the bulb of the urethra, where it touches the anus, its course is directly across the perinæum; and its relation to the perinæum and anus is very direct and evident, while its relation to the penis is rather doubtful. Often there is a second muscle of the same origin and insertion running like this across the perinæum, named TRANSVERSALIS PERINÆI ALTER.

This transverse muscle may, by bracing up the bulb to the arch of the pubis, have some effect in stopping the vein on the back of the penis, and so producing erection; but its chief use must be in preventing the anus from being too much protruded in discharging the fæces, and in retracting it when it is already protruded.

CLII. The ACCELERATOR muscle is not a single muscle, as it is often described: it is manifestly a pair of muscles surrounding the whole of the bulb of the urethra. For there is

along the lower face of the bulb a white and tendinous line, corresponding with the outward line or seam of the perinæum. This line distinguishes the bellies of the two muscles: the fibres of each side surround their proper half of the bulb with circular fibres, winding obliquely round the bulb; and each muscle ends in its separate tendon, which is delicate and small, and which, leaving the bulb of the urethra, turns off obliquely to the side, so that the tendon of each side goes out flat and thin upon the crus penis of its own side, a little higher than the insertion of the erector penis; and thus it embraces the bulb itself with its two crura. We know and feel its convulsive involuntary action in throwing out the seed: and we are conscious that we use it as a voluntary muscle in emptying the urethra of the last drops of urine.

CLIII. The SPHINCTER ANI muscle is a broad circular band of fibres which surrounds the anus. It arises from the point of the os coccygis behind. It sends a neat small slip forwards, by which it is attached to the back part of the accelerator muscle. It is of a regular oval form, and is two inches broad, and is for a very obvious reason stronger in man than in animals. Some choose to enumerate two sphincter muscles, of which this is the external or cutaneous; and what they describe as the internal one, is merely the circular fibres or muscular coat of the intestine, strengthened a little towards the anus, but not a distinct muscle. Its effect is to shut the anus.

CLIV. The LEVATOR ANI muscle is described as a pair of muscles, one from each side: but it is properly one broad and thin muscle, which arises from the internal surface of all the fore part of the pelvis; and from its breadth it has been named MUSCULUS ANI LATUS. It continues its origin from the internal surface of the pubis, all the way round to the sacrum. It grows gradually smaller as it goes downwards to surround the anus. So it is inserted into the circle of the anus, into the point of the os coccygis, and is mixed with the sphincter ani muscle. The whole pelvis is lined with it like a funnel or inverted cone; the wider part representing its origin from the pelvis, the narrower part its insertion into the anus. The whole bladder is surrounded and covered by this muscle; the urethra passes through a split in its fibres; and no operation of lithotomy can reach the bladder from below without cutting through this muscle. It raises the anus, and at the same time dilates it; opening the anus for the passage of the fæces, and supporting it, so as to prevent its being protruded. Thus it is not for shutting the anus, as some have supposed, but is the direct antagonist of the sphincter ani muscle. By enclosing the bladder, the levator ani acts upon it also; for the neck of the bladder passing

through a slit in its fibres, while the levator ani is acting, this slit is drawn, as it were, round the neck of the bladder, and so the urine is for the time prevented from flowing. It is as a sphincter to the bladder, which prevents our passing the urine and fæces at the same moment. By surrounding the lower part of the bladder, and enclosing the prostate gland, and the vesiculæ seminales, which lie upon the back of the bladder, this muscle affects these parts also; and is perhaps the only muscle which may be supposed to empty the vesiculæ, or to compress the gland, pulling upwards at the same time, so as to press the back of the penis against the pubes, to maintain the erection, and to assist the accelerator muscles. By enclosing the bladder, vesiculæ, prostate, and anus, this muscle produces that sympathy among the parts which is often very distressing; as in gonorrhœa, the stone in the bladder, constipation, piles, and other diseases of these parts; for piles, constipation, or any cause which may excite the action of the levator muscles, will cause erections, a desire to pass the urine, and an obstruction in the discharge of it.

CLV. The MUSCULUS COCCYGÆUS is a thin, flat, muscle, which arises by a narrow point from the inside of the pelvis at the spine of the os ischium: is implanted, expanded, and fleshy, into the whole length of the os coccygis; can be useful only by pulling up the point of the os coccygis, which is just equivalent to raising the circle of the anus; so that from every circumstance of its form and use, it might be fairly enough described as being merely the back part of the levator ani muscle.

The perinæum, where the bulb begins, is the point into which all the muscles are united; for the accelerator muscle, and the sphincter ani muscle, touch at the beginning or point of the bulb; and a small pointed slip of the sphincter ani, going upon the bulb, connects them firmly together. The transversalis perinæi comes across the perinæum from either side; and the levator ani muscle comes down to meet the sphincter; so that the sphincter ani, the levator ani, the transversalis perinæi, and the accelerator urinæ muscles, all meet in one point, viz. the back of the bulb. They secure the perinæum, and support the heavy viscera of the abdomen: if they be unskilfully cut in performing lithotomy, it will be difficult to extract the stone. In that operation the incision passes by the side of the anus, and on the inside of the tuber ischii; and our knife accordingly cuts clean across the transverse muscles, which stand as a bar across the perinæum: it passes by the side of the erector muscle, need not touch it, or touches it slightly, and by a sort of chance: it must not touch the accelerator muscle; for whoever says he cuts the accelerator, cuts too low, and performs his ope-

ration ill. After the first incision we get deep into the pelvis, and cut the levator ani. The surgeon does not observe these muscles, on account of any danger which may attend wounds of them, but takes them as marks for the true place of his incision; and a good operator will be careful to have them fairly cut, that they may be no hinderance to the extraction of the stone.*

CHAP. VIII.

MUSCLES OF THE THIGH, LEG, AND FOOT.

MUSCLES MOVING THE THIGH-BONE.

THE muscles belonging to the thigh-bone arise all from the pelvis or trunk. The PSOAS MAGNUS and ILIACUS INTERNUS come from within the pelvis, at its fore part, and, passing under the femoral ligament, go down to be implanted into the trochanter minor; and by this obliquity of their insertion, they turn the toes outwards, and bend the thigh. Other muscles come from the lower and fore part of the pelvis; as the PECTINALIS, TRICEPS, and OBTURATOR EXTERNUS, which arise from the arch of the pubes, and go down to be implanted into linea aspera, and lesser trochanter; and they, pulling the thigh towards the body, are called the ADDUCTORS. Others arise from the sacrum and back part of the pelvis, as the GLUTÆI, which, coming directly forwards to be implanted into the greater trochanter, pull back the thigh; and a fourth set coming also from the internal surface of the pelvis, viz. the OBDURATOR INTERNUS, and the PYRAMIDALIS, come out through the back openings, turn round the pelvis as round a pully, and

* The detrusor urinæ is but the muscular coat of the bladder; the sphincter vesicæ, or muscle of the prostates, is but a denser fasciculus of this common coat of the bladder. I should no more think of describing them here than of describing the coats of the intestines or stomach. These muscles of internal parts, with the muscles of the internal ear, &c. I reserve for those books which describe the organs and viscera.

roll the thigh, and draw it back. This completes the catalogue of those muscles which move the thigh.

1. The PSOAS MAGNUI, ILIACUS INTERNUS, PECTINEUS, TRICEPS, OBTURATOR EXTERNUS, which, coming from before, are inserted into the lesser trochanter, and bend the thigh.

2. The GLUTÆI, GEMINI, PYRIFORMIS, OBTURATOR, INTERNUS, and QUADRATUS, which come from behind, are implanted into the great trochanter, and extend the thigh; and it hardly need be remembered, that as, when the arms being fixed, their muscles raise the weight of the body, as in climbing or in turning over a bar, by grasping with the hands; so the muscles of the thigh move that thigh only which is loose and free from the weight of the body, while the muscles of the other thigh, which is fixed by the weight of the body, move not the thigh, but the trunk upon the thigh; so that our walking is performed not so much by the muscles of the thigh moving the limb, as by their moving the pelvis, i. e. rolling the trunk upon the limb.

MUSCLES MOVING THE THIGH.

1. THE THIGH IS MOVED BACKWARDS AND OUTWARDS

By the Glutæus maximus,	which is implanted into the	Linea aspera,
——— medius,		Trochanter major,
——— minimus,		Top of trochanter.

2. THE THIGH IS MOVED BACKWARDS, AND ROLLED UPON ITS AXIS.

By the Pyriformis,	which is implanted into the	Root of the trochanter,
Gemini,		———
Obturator externus,		———
——— internus,		———
Quadratus,		betwixt the trochanters.

3. THE THIGH IS MOVED FORWARDS AND INWARDS

By the Psoas magnus, Iliacus Internus,	which is implanted into the	Trochanter minor,
Pectinalis, Triceps,		Linea aspera,

FASCIALIS. I begin with this muscle, as it is necessary in the dissection. The thigh is inclosed in a very strong sheath, which, like that of the arm, sends down among the muscles strong tendinous septa or partitions; and the muscles are inclosed in these septa; and the great muscles of the leg are supported by it in their strong and continual actions. The

tendinous fascia of the thigh arises chiefly from the spine of the ilium, partly (over the groin) from the external oblique muscle of the abdomen. Every fascia has something added by each muscle, and takes a new increase and adhesion at each bone which it passes. It is always strengthened by adhesions to joints, and comes down from them thicker upon the muscles below; and so this fascia of the thigh, which arises chiefly from the spine of the ilium, descends, covering all the muscles of the thigh: it sends partitions down to the linea aspera and trochanters; it has a new adhesion and a new source of tendinous fibres at the knee; it adheres most remarkably at the inner side of the tibia, and then descends to the brawn; it covers all the leg, and is again reinforced at the ankle: and this I believe to be a juster history than the common idea of making it an expansion of the small tendon of the small muscle, which I am now to describe; for the fascialis is too essential to the strength of the leg to depend upon so inconsiderable an origin, and would be found there though this muscle were away, as in the palmaris of the hand.

This fascia consists properly of two plates; one is that which comes down from the crest of the ilium, and from the muscles of the belly; the other, that which arises purely from the tendon of the musculus fascialis, and which is, at the same time connected with the capsular ligament of the femur and with the trochanter; and so the muscle lies betwixt the two plates of the fascia; and as the fascia at this part takes at least a reinforcement from the capsular ligament, and from about the trochanter major, the fascialis muscle may be said to be inserted into the trochanter.

So this great tendinous fascia has these connections: the crest of the ilium; the ligament of Paupart at the rim of the belly; the crest and arch of the pubes; the tuber ischii, and so back along the coccyx to the ridge and processes of the sacrum; the ligament of the joint, the great trochanter, and the linea aspera, all the way down to the knee, where its last adhesion is very strong, and from whence it comes off again much strengthened.

It is thicker on the outer side and back part, and very thin on the inner side of the thigh; and it dives with perpendicular divisions among the muscles of the thigh.

CLVI. The FASCIALIS MUSCLE. The muscle is rightly named tensor vaginæ femoris; for hardly any other use can be assigned. It arises from the upper spinous process of the ilium, i. e. from the fore part, or very point of its spine, by a tendon of about an inch in length. It is very small at its origin and at its termination. It is thick and fleshy in the middle,

swelling out. It extends downwards, and obliquely backwards, almost to the middle of the thigh; and there it terminates obliquely, betwixt the two lamellæ of the membrane to which it belongs.

Its use is chiefly to make the fascia tense, to prepare the muscles for strong action; and perhaps, by its adhesions about the trochanter, it may have some little effect in rolling the thigh, so as to turn the toes inwards, and oppose the Gemini.

CLVII. PSOAS MAGNUS.—This and the following muscle come from within the body to move the thigh forwards. This is a very long and fleshy muscle; of considerable strength; of constant use; perpetually employed in moving the thigh forwards, or in supporting the pelvis upon the thigh-bone, so as to preserve the equilibrium of the body.

It is named from PSOA LUMBUS; is a large round muscle, very strong, of great length, filling up all the space upon either side of the spine, and bounding the pelvis at its side. It comes from under the ligamentum arcuatum of the diaphragm; for it arises first by its uppermost head from the last vertebra of the back, then successively from each of the vertebræ of the loins. It sticks close to the lumbar vertebræ; for it arises, not only from the transverse processes, but from the sides of the bodies. These heads do not appear; for they are covered by the body of the muscle, which goes down thick and round till it reaches the sacro-iliac symphisis, and then, being united to the internal iliac muscle, they descend through Paupart's ligament.

CLVIII. The PSOAS PARVUS does not, like this, belong to the thigh, but is a muscle of the loins which arises along with this one from the last vertebra of the back and the first of the loins. It is a small and delicate muscle; ends in a slender tendon, which goes down by the inner side of the great psoas, but does not go out of the pelvis along with it: it stops short, and is implanted into the brim of the pelvis, into the os ilium, near the place of the acetabulum: it bends the spine upon the pelvis. This muscle is more regular in the monkey: in the dog it is seldom wanting. It is said to be more frequently found in women than in men: in both it often is not to be found; but sometimes in strong and big men three psoas muscles have been found.

CLIX. The ILIACUS INTERNUS is a thick, very fleshy, and fan-like muscle, which occupies the whole concavity of the os ilium.

Its origin is from the internal lip of the crista ilii: it adheres to all the concave surface of that bone down to the brim of the pelvis; to the fore part of the bone under the spinous process;

and to a part also of the capsular ligament of the joint: all its radiated fibres are gathered together into a tendon at the ligament of Paupart. This tendon is longer on the lower than on the upper surface: for below it slides on the pubes as upon a pulley, and continues tendinous, that it may bear the friction; but above it is unconnected, or it is connected only by loose cellular substance; and there it is quite fleshy. Just under the ligament the two tendons are joined; whence they bend obliquely round to be implanted into the lesser trochanter.

The psoas magnus and iliacus internus are two very powerful muscles. Their chief use is to bend the thigh, and more peculiarly of the lumbar one to support the body. The great blood-vessels come down along with these two muscles: the muscles and vessels are both surrounded with loose cellular substance. Matter often forming behind the abdomen, round the psoas muscle, is named the psoas abscess; and penetrating under Paupart's ligament, bursts in the thigh at last, and is commonly fatal.

CLX. The PECTINEUS, or PECTINALIS, is so named from its arising at the pecten or pubes; is a broad flat square muscle; lies along side of the last described muscles; and is inserted with their common tendon. It arises flat and fleshy from that line of the pubes which forms the brim of the pelvis, and is implanted into the linea aspera by a tendon flat and long, pretty nearly of the same extent and shape with its origin.

This muscle lies immediately under the skin and fascia lata; and by its bending round under the thigh-bone it has three actions: to close the knees together; to pull the thigh forward; to perform rotation, turning out the toe; and in certain positions of the limb it will pull the thigh back, assisting the extensor muscles.

CLXI. The TRICEPS FEMORIS is a broad flat muscle, with three heads, arising from the pubes, and inserted into the whole length of the linea aspera down to the condyle, and serving for pressing the knees together or bringing the thigh forwards.

The triceps consists of three heads, which lie in different layers, one above the other; and have so little connection among themselves, that they have been more commonly, and I think properly, described as three muscles. These three parts of the muscle are indeed for one common use: but they are of very different forms; for they do not even lie on the same plane: one is long: another shorter by one half; a third longer than both the other two; so that they have been commonly described under the names of ADDUCTOR PRIMUS or LONGUS;

ADDUCTOR SECUNDUS or BREVIS; ADDUCTOR TERTIUS or MAGNUS.

1. The ADDUCTOR LONGUS is the uppermost layer: its border (for it, like the pectinalis, is a flat muscle) ranges with the border of the pectinalis. It arises from the upper and fore part of the pubes by a short roundish tendon, very strong: it swells into a thick fleshy belly, not round, but flattened; the belly grows flatter as it goes down towards the thigh-bone; it ends in a flat and short tendon, which is inserted web-like into the linea aspera in all its middle part, viz. about four inches. Thus the muscle is of a triangular form, with its base in the linea aspera, and its apex on the pubes. Its head or origin lies betwixt the pectinalis and the gracilis: its upper edge ranges with the pectinalis; its lower edge lies upon the triceps magnus. It is called longus, because it is longer than the next head.

2. The ADDUCTOR BREVIS lies under the adductor longus, and is of another layer of muscles; for as the first layer consists of the pectinalis, triceps longus, and gracilis, this layer consists of the obturator externus, triceps, brevis, and triceps longus. The triceps brevis is exceedingly like the former, in rising near the symphisis pubes, by a thick and flattened tendon, swelling like it into a strong fleshy belly; like it, it grows flat, and is inserted by a short flat tendon into the inner trochanter and linea aspera. But it differs in these points: that it is less oblique; for this muscle being shorter, goes more directly across betwixt the pelvis and the thigh: that it is placed higher than the last; so that whereas the adductor longus is inserted into the middle of the thigh bone, this one is inserted into the lesser trochanter, and only the upper part of the linea aspera; and the triceps longus is a superficial muscle, while this is hidden under it and behind it. The longus takes its rise from the very crest of the pubes; this takes its origin from the fore part of the pubes, from the limb just under the crest, so as to be immediately under the head of the longus.

3. The ADDUCTOR MAGNUS, the third head of the triceps, is a very long and flat muscle, lying behind the other heads. It arises by a short tendon, just under the tendon of the adductor brevis: it continues to have a fleshy origin all down the ramus and the tuber ischii (i. e.) from the flat edge of the thyroid hole. From this broad origin it goes to be implanted into the thigh-bone the whole length of the linea aspera, its fibres having various degrees of obliquity according to their insertion; for the uppermost fasciculi go almost directly across, to be inserted flat into the upper part of the linea aspera; the succeeding fasciculi go more and more obliquely as they descend, the lower part of the muscle following that rough line which leads

to the condyle; and the last fibres of all are implanted by a tendon of considerable length into the condyle itself. This adductor magnus makes, as it were, a flat partition betwixt the fore and back parts of the thigh; and it is about three inches above the condyle that the great artery passes betwixt this tendon and the bone, perforating the triceps, to get from the fore to the back part of the thigh, and down into the ham.

The use of all these muscles is entirely the same, making allowance for their various degrees of oblique insertion; and they must be very powerful, by the great distance of their origins from the centre of that bone which they move: so that while other muscles pull in a direction very oblique, these three heads of the triceps must pull almost at right angles, the most favourable direction of all.

CLXII. The OBTURATOR EXTERNUS is named after the obturator ligament, from which it arises. The ligament and the muscles shutting up the foramen thyroideum are named OBTURATORS; and it is sometimes named ROTATOR FEMORIS EXTRORSUM, from its turning the thigh outwards. It arises from the ramus of the ischium and pubes where they form the margins of the thyroid hole; and from the outer surface of the ligament, which it occupies entirely, leaving only room for the obturator vessels and nerves. It is a short muscle; its origin is broad, and its insertion narrow, so that it is of a conical form; for the flesh of this muscle is gathered very soon into a round short tendon, which twist under the thigh-bone betwixt it and the pelvis: so that it is in a manner rolled round the thigh-bone, being inserted into the root of the great trochanter. It pulls the thigh forwards, but is more peculiarly a rotator of the thigh. This muscle is of the second layer; and the succession of all the muscles is this: the upper layer consists of the psoas and iliacus, where they come out from the abdomen; of the pectinalis; and of the long head of the triceps: the second layer consists of the short head of the triceps: and the third layer consists of the obturator externus at the upper part, and of the triceps magnus, or third head of the triceps, all down to the condyle.

GLUTÆI.—There are three glutæi muscles, each under the other, and each smaller than the muscle which covers it. The FIRST, arising from the back part of the ilium, the back of the sacrum, and the sacro-sciatic ligament, forms the whole hip, and descends so low as to be inserted into one third of the length of the linea aspera, and into the root of the great trochanter.

The SECOND arises from all that portion of the ilium which

is before this one, and from the back of the bone, and goes down to be inserted into the very top of the great trochanter.

The THIRD arises from the back of the bone below the last, down to the acetabulum and sacro-sciatic sinus; and it is inserted into the root betwixt the apex of the great trochanter and the neck of the bone.

CLXIII. The GLUTÆUS MAXIMUS arises from the back of the ilium one half its length; from the joining of the ilium and sacrum; from all the spines and irregularities of the sacrum; and from the sacro-sciatic ligament. Its thick fleshy fasciculæ come in a winding and oblique direction down to the thigh-bone; and, being gathered into a flat and pretty broad tendon, it is inserted into the root of the trochanter major, and down three inches of the linea aspera. This is one of the largest and most fleshy muscles of the body; covers all the other muscles of the hip; forms the contour of the hip; pulls the thigh backwards, or the body forwards upon the thigh when the thigh is fixed: and being a wide spreading muscle, which in a manner surrounds its joint, its different portions act with different effects; not only according to their natural direction, but according to the accidental positions of the pelvis with regard to the thigh-bone.

CLXIV. The GLUTÆUS MEDIUS OR MINOR is smaller than the former, but like it. It arises from all the outside of the ilium not occupied by the glutæus major. It, like the other, is a fan-formed muscle; for its fibres converge from its broad origin in all the back of the ilium, to form a short flat tendon, which is inserted into the back or into the very top of the great trochanter. It lies in part under the glutæus maximus; but its chief part lies before the glutæus maximus: and as certain portions of the muscle are before the thigh-bone, there are positions of the pelvis and thigh-bone in which it will pull the thigh forwards, although its proper office is to assist the glutæus magnus in pulling the thigh backwards, and moving it outwards from the body.

CLXV. The GLUTÆUS MINIMUS is a small radiated muscle, which lies deep, and quite under the former. It has, compared with the former, a very narrow origin; for it arises chiefly from the lowest part of the back of the ilium, viz. that part which forms the socket for the thigh-bone, and a little higher up; and from the border of the sciatic notch. It forms a short, flat, and strong tendon, which is fixed under the root of the trochanter major, betwixt the trochanter and the neck of the bone: so that these muscles are inserted in this succession; first, the great glutæus, below the root of the trochanter, and

into the linea aspera; the middle glutæus into the back and top of the trochanter; and the smallest of the glutæi is implanted into the roughness under the root of the trochanter.

GEMINI.—The gemini are two muscles, or rather one biceps muscle; but the heads are so distinct that they are reckoned two, and so much alike that they are named GEMINI.

CLXVI. The uppermost, the larger and stronger muscle, arises from the spinous process of the os ischium.

CLXVII. The second, or smaller head, arises in like manner from the tuber ischii, upon its ball or outer end. They are fleshy in their whole length. They meet and unite their tendons at the great trochanter. They are inserted firmly, along with the following tendon, at the root of that process.

CLXVIII. The PYRIFORMIS, sometimes called iliacus internus or pyramidalis, comes from the hollow of the sacrum, runs in the same line with the lesser glutæus, and is inserted with the two last named muscles in the root of the great trochanter.

Its origin is from the hollow of the sacrum, rising from the vertebræ of that bone by three or four small fleshy digits, and from the sacro-sciatic notch; it runs betwixt the glutæus minor and the gemini, and its round tendon is inserted betwixt them, somewhat connected with each.

The pyriformis, gemini, obturator internus, and quadratus, form what some anatomists have called MUSCULI QUADRAGEMINI; and they are so much alike in insertion and use, that it would be waste of time to repeat what has been said of the gemini and obturator.

This muscle, the pyriformis, like the others, rolls the thigh outwards. Its name is from its shape.

CLXIX. The OBTURATOR INTERNUS, once named MARSUPIALIS or BURSALIS, arises from all the internal surface of the obturator ligament, and from all the edges of the thyroid hole, from the ilium, ischium, and pubes; so it arises within the pelvis; comes out by turning round the ischium in the notch betwixt its tuber and its spine. Its origin is therefore circular and fleshy. It runs along the inside of the os ischium, turns round that bone betwixt the spinous process and the tuber. The hollow there is guarded with cartilage; and this tendon runs in the hollow, like a pully round a rope; passing this, it runs betwixt the two legs of the gemini, and its tendon is united to theirs; and the three, appearing almost like one tendon, are inserted together into the root of the trochanter major. These, then, might with some propriety be named one muscle; all the three, viz. the two gemini muscles and the obturator muscle, passing between them, were once accounted as one muscle, and then it

seemed to be a muscle with two bellies and an intermediate tendon; and this intermediate tendon, with two fleshy ends, give it the appearance of a purse, and thence it was named MUSCULUS MARSUPIALIS, or BURSALIS.

CLXX. The QUADRATUS FEMORIS, is a thin flat muscle, passing in a transverse direction betwixt the tuber ischii and the thigh-bone.

It arises from the lower and flattened surface of the TUBER ISCHII by a short tendinous beginning. It goes a little obliquely upwards and outwards, and is inserted into the back of the great trochanter, in that roughness which is found just where the trochanter is joined to the bone, and goes obliquely betwixt the trochanter major and the trochanter minor.

It rolls the thigh-bone, so as to turn the toe outwards, and pulls it almost directly backwards.

The MOTIONS of the THIGH must be performed by many very strong muscles, as it moves under the weight of the whole body; and it seems to be curiously contrived, that the muscles fit for moving the thigh forward should, in certain positions of the thigh, move it backwards; also giving an increase of strength to that motion of the thigh in which most strength is required.

There are but two, or chiefly two, points for insertion; the trochanter major and the trochanter minor. These two points are so oblique, that no one muscle, nor set of muscles, performs any direct motions; for they all twist round the bone's axis, to get at their insertion. The glutæi, the pyriformis, the gemini, the quadratus, the obturator internus, and obturator externus, all bend round the axis of the thigh-bone, to reach the TROCHANTER MAJOR. These now may be called the abductors of the thigh, to pull it outwards; but we should conclude from this direction, that they could not pull the thigh backwards, for the thigh-bone would turn on its axis and elude their action.—The psoas magnus, the iliacus internus, the pectinalis, and the triceps, do in the same manner go round the inner side of the bone: the two first to be implanted into the trochanter minor, the two latter into the linea aspera, just below it. These are justly named adductors of the thigh: their chief use is to draw the thighs together: and this is the combined effect of these two sets of muscles. When the adductors act by themselves, they pull the thigh forwards, moving the leg, rolling the thigh-bone, and turning the toe out in a graceful step; which is most peculiarly the effect of the pectinalis and triceps. But when we are to finish the motion, by pulling forward the body, which is the same with pulling back the thigh, it is not merely the

antagonists of these muscles, as the glutæi, the gemini, &c. which must act. Were the glutæi to act alone, they would rather turn the thigh upon its axis outwards than pull it back; but the triceps, &c. act again in conjunction with the glutæi, &c. and by the action of the triceps, the inner trochanter is fixed; the further rolling of the thigh is prevented; the full effect is given to the glutæi muscles. When the glutæi act, they pull the thigh directly backwards, assisted by the triceps, pectinalis, and others: for now the thigh-bone is so far advanced before the body, that those muscles, as the triceps, which were benders of the thigh in its first position, are extensors when it is advanced a step before the body; or, perhaps, it will be more explicit to say, that when the thigh is moved one step before the body, the iliacus internus, psoas magnus, and triceps muscles, co-operate, agree with the glutæi muscles in bringing the trunk forwards to follow the limb, and then in fixing and stiffening the trunk upon that limb till the other thigh is advanced a second step before the body.

The MUSCLES of the LEG are the most simple of all: for the knee is a mere hinge, at least it is so in all our ordinary motions; so that there is no action to be performed but those of mere flexion and extension; and there are only two classes of muscles to be described, the extensors and the flexors of the leg.

1. The EXTENSORS of the LEG. The only muscles which extend the leg are those four, which may be very fairly reckoned a quadriceps extensor cruris. Indeed the French anatomists arrange them so. Sabbatier calls them the triceps femoris. These muscles, which all converge to the patella, and are inserted in it, are:

Rectus Femoris,	Vastus Externus,
Cruræus vel Femoræus,	Vastus Internus.

And these are all implanted by one tendon; because the joint being a hinge, bending only in one direction, its muscles could have given but one motion, however oblique their origin and course had been.

2. The FLEXORS of the LEG are one on the outside and four on the inside of the leg; the tendons of the outside being implanted into the upper knob of the fibula, and those in the inside into the rough head of the tibia, forming the hamstrings, and extending their tendons or aponeurotic expansion downwards upon the leg.

INSIDE FLEXORS.

Sartorius,	Gracilis,
Semitendinosus,	Semimembranosus.

OUTSIDE FLEXOR.
Biceps.
FLEXOR lying in the HAM.
Musculus Poplitæus.

EXTENSORS OF THE LEG.

CLXXI. The RECTUS FEMORIS, sometimes RECTUS CRURIS, is so named from its direction; it is a thin flat muscle, and arises by two heads. The first or greater head arises from the lower spinous process of the ilium by a short round tendon; its second head is in a different and in somewhat of a curved direction; for it comes from the head of the acetabulum and from the capsular ligament. These join together, and form a flat tendon of four inches in length, which becomes gradually fleshy and larger down to its middle, and then again contracts towards the patella in the same gradual manner. There is a middle tendinous line running the whole length of the muscle, especially conspicuous on its back part; and towards that central line all the muscular fibres converge.

The rectus is united at the sides to the vasti; at the back part to the cruræus; and its tendon, along with that of the cruræus, goes to be directly implanted into the rotula of the knee.

The rectus cruris is the first of those muscles which Sabbatier calls the TRICEPS FEMORIS; and surely they may be as properly named thus as the TRICEPS CUBITI EXTENSOR.

This large mass of muscle or flesh enwraps the whole of the thigh-bone behind as well as before: for, first, the CRURÆUS arises fleshy from all the fore part of the bone; the VASTUS EXTERNUS from the great trochanter, and all the back part and outer side of the bone; and the VASTUS INTERNUS arises, in like manner, from the lesser trochanter, and all the inner side of the bone, from the trochanter major all round to the origin of the cruræus.

CLXXII. The CRURÆUS arises from the fore part of the TROCHANTER MINOR; and it continues its origin from the fore part of the femur, the whole way down to within two inches or little more of the patella. About three inches from its origin it is joined by the VASTUS EXTERNUS, which unites with it at the outer edge and fore part; and the VASTUS INTERNUS comes into it about five inches below its origin, and joins it at the inner edge and fore part. At its lower part it is joined to

the tendon of the rectus, to form but one large tendon, which is inserted into the rotula.

Under the cruræus are sometimes found two little muscles, or rather two little slips of this muscle, which are quite distinct. They arise on the fore part of the thigh-bone, two or three inches above the capsule of the joint; and they are inserted into the capsule on each side of the patella, evidently for the purpose of pulling it up, to prevent its being catched; and when these two (SUBCRURÆI) are not found as distinct muscles, some fibres of the cruræus supply their place.

CLXXIII. The VASTUS EXTERNUS is the largest of these three muscles.

Its origin is by a pretty thick and strong tendon from the lower and fore part of the trochanter major; and it continues its origin from the root of the trochanter all down the linea aspera to that rough line which goes to the inner tuberosity of the thigh-bone.

It touches the end of the cruræus about four inches below its origin, and continues attached to it the whole way down; and then it forms a flat tendon which connects itself with the tendon of the RECTUS FEMORIS, and then embraces in a semicircular manner the outside of the patella. And several of the fibres of this aponeurosis not only cross over the rotula, but go down over its opposite side to glide along the head of the tibia, and to be inserted into the inner side of the knee.

CLXXIV. The VASTUS INTERNUS is neither so large nor so fleshy as the VASTUS EXTERNUS; but it is exceedingly like it in all other respects.

It arises from the fore part of the trochanter minor just under the insertion of the psoas magnus; and it continues its origin from the linea aspera the whole way down to the inner condyle, exactly opposite to the origin of the vastus externus, so that their origins meet; they leave just a channel betwixt them. The vastus internus, very soon after its origin, joins itself to the cruræus, or middle portion, and accompanies it in all its length: and at the distance of two inches from the rotula it unites itself with the tendon of the cruræus at its internal edge; and this tendon completes that junction which unites the four muscles into a quadriceps cruris. This vastus internus descends much lower, in a fleshy form, than the external vastus does; and forms that fleshy cushion which covers the inner side of the knee joint. Its tendon embraces the rotula somewhat in the same circular form with that of the vastus externus; and, like the externus, it sends some fibres across the knee-pan, to be inserted in the outer part of the head of the tibia.

The RECTUS, and the VASTUS EXTERNUS, INTERNUS, and CRURÆUS, form one large mass of flesh, which embraces and incloses all the thigh-bone; and they are so connected, that the cruræus cannot be separated, and cannot be neatly distinguished.

The use of these four muscles is evident to extend the leg and to bend the thigh on the trunk, or reciprocally to bend the trunk on the thigh. This, or these two motions alternately, is the common use of these muscles, as in walking; and they are most peculiarly useful in running and leaping.

After describing a large mass, conjoined in one tendon, and concurring in one simple action, it is superfluous to say that its power must be great. This power must be still further increased by the rotula, which removes the force from the centre, and gives the advantage of a pulley, which it really and truly is: without this pulley these muscles could be of no use in certain situations; for instance, in the recumbent posture: for then the extending muscles being in the same line with their bones, could have no farther power; but the rectus, by the pulley of the rotula, and by its attachment to the basin, raises the trunk, or at least helps the psoas, the iliacus, and the muscles of the belly.

The rotula is again attached to the tibia by a strong ligament, to sustain the pulling of these great muscles.*

FLEXORS OF THE LEG.

CLXXV. The SARTORIUS or TAYLOR'S MUSCLE, is so named from its bending the knees and drawing the legs across. It is the longest muscle, and a very beautiful one: it extends obliquely across the whole length of the thigh, crossing it like a fillet or garter, about two inches in breadth.

It arises from the upper spinous process of the os ilium, by a tendon about half an inch in length; its thin flat belly extends obliquely across the thigh, like a strap, and is inserted in the

* These muscles are in continual action: for their office is to resist the bending of the knee, which would happen by this incumbent weight of the body; so that the continual support of the body depends wholly on these muscles; and they are the great agents in running, leaping, walking, &c. Since, by extending the knee, they raise the weight of the pelvis and trunk, and of all the body, they must be very powerful; and accordingly when they are weighed against their antagonist muscle, we find them greatly to exceed; for the QUADRICEPS, i. e. the rectus, cruræus, and vasti, will weigh four pounds, while the BICEPS, &c. their antagonists, weigh but two pounds. This experiment was often repeated by the great Cowper for Mr. Brown, who was delivering lectures on muscular motion.

same oblique form into the inner tubercle of the head of the tibia; its aponeurosis spreads pretty widely, going over the whole joint of the knee a thin sheet of tendon.

From the oblique position of the muscle, it might in action change its place; but it is closely embraced by the fascia lata, and is tied by such adhesions as form something like a peculiar sheath of itself.

It turns the thigh like the quadrigemini and obturator muscles. It also bends the leg upon the knee; and when the leg does not yield, it bends the thigh upon the pubes; or where the thigh also is fixed, it bends the body forwards: but in performing that action, whence it has its name, it does all these; for first the leg and thigh are rolled, then the thigh is bended towards the belly, then the legs are bent to draw them across. Though a small muscle, yet it is of great power from its origin, and in some degree from its insertion also; being much removed from the centre of motion.

CLXXVI. The GRACILIS, sometimes called RECTUS INTERNUS FEMORIS,* is a small, flat, thin muscle, in its general shape somewhat like the sartorius.

It arises by a flat tendon of two inches in length from the pubes and near the symphysis; and it passes immediately under the integuments down to the knee: it passes by the inner condyle of the knee, in the form of a short round tendon; and as it bends behind the head of the tibia, it is bound down by a bundle of tendinous fibres, which crossing it, go to the back part of the leg. After passing the head of the tibia, it turns obliquely forwards and downwards; it here runs behind the tendon of the sartorius, and before that of the semitendinosus. It is inserted with the sartorius into the side of the tuberosity at the top of the tibia.

This muscle runs also in a line so wide from the centre of motion, that its power is very great. It serves chiefly as a flexor of the leg: when the leg is fixed, it must, by its origin from the pubes, be a flexor of the thigh, and an adductor in nearly the same direction with the pectineus and triceps; and it is worth observing, that while the knee is straight, the sartorius and the gracilis cannot bend the knee: they, on the contrary, keep it steady and firm: but when the knee is bent, they come into action; for in proportion as the muscles which have made the flexion are contracted, they are less able to contract

* GRACILIS is from its smallness; RECTUS INTERNUS is from its straight direction.

farther; and therefore it is desirable that more muscles should come into play.

CLXXVII. The SEMITENDINOSUS is so named from its lower half being composed of a small round tendon; and as tendon was once misnamed nerve, this is the SEMINERVOSUS of Winslow, Douglas, and others.

Its origin is from the tuberosity of the ischium (along with the semimembranosus, and touching the biceps) by a short thick tendon. It also arises by many oblique fasciculi of fibres from the posterior portion of its opposite muscle the biceps cruris. This cross connection betwixt the two muscles continues for three inches down from the tuber ischii; it then departs from the biceps, goes obliquely inwards, and is flattened and contracted into a tendon six inches from the knee. Its tendon then becoming smaller and rounder, passes down behind the inner tubercle of the knee; and getting round the head of the tibia, it comes forward to be inserted into the tuber at the head of that bone. At this place the tendon grows broad and flat; it is expanded, and as it were grasps the inner side of the knee; its upper edge is joined to the lower edge of the tendon of the gracilis, so that the sartorius, gracilis, and semitendinosus, are implanted like one muscle; and this tendinous expansion seems like a capsule for enclosing the heads of the tibia and femur, and for strengthening the knee-joint. The semitendinosus bends the leg.

CLXXVIII. The SEMIMEMBRANOSUS has its name from the muscle, which is flat, thick, and fleshy, beginning and ending with a flattened tendon, somewhat like a membrane, but infinitely thicker and massier than such a name should imply.

It arises from the tuber ischii, before the semitendinosus and biceps. It arises a broad, thin, and flat tendon, of about three inches in length. It becomes fleshy and thick in its middle, but it soon becomes thinner again, and terminates in a short tendon, which gliding behind the head of the tibia, is inserted there.*

This muscle has little connection with any other. It lies under, or, more properly speaking, on the inside of the semitendinosus, and the two together form the hamstrings. The hamstring muscles contribute also to another motion. Though,

* The two tendons of this muscle, the membranous tendon at the head, and this smaller one by which it is inserted, stand so obliquely, that the muscular fibres betwixt them must be very oblique; for the membranous tendon descends low upon the back part or edge, and the tendon of insertion begins high upon the fore edge of the muscle.

when extended, the tibia cannot roll, yet when we sit with our knees bent, it can roll slightly ; and such rolling is accomplished by these muscles. All these muscles which bend the leg, and which consequently extend the thigh at the same time, are muscles of very great power ; because they arise in one common point, the tuber ischii, and that point is very far distant from the centre of motion.

There is still one small muscle, a flexor of the leg, which performs this rotation during the bent state of the knee with most particular power.

CLXXIX. The MUSCULUS POPLITÆUS, which is so named from its lying in the ham, is a small triangular muscle, lying across the back part of the knee-joint, very deep under the hamstrings, and under the muscles of the leg.

Its origin is from the outer condyle of the thigh-bone, and from the back part of the capsule of the joint. Its tendon is short and thick, but of no great extent. It passes fleshy behind the knee-joint ; and it is inserted broad into a ridge on the back part of the tibia ; so that by its small origin and broad insertion it is a fan-like muscle ; its fibres being almost transverse, and its lower fibres nearly perpendicular. Besides bending the leg, it is useful by pulling aside the capsule to prevent its being catched.

CLXXX. The BICEPS CRURIS, so named from having two heads, a long and short one, lies immediately under the skin, in the back part of the leg, running down from the pelvis to the knee, to form the outer hamstring.

It is the single flexor on the outside of the thigh. Its origin is from the outer part of the tuber ischii by a tendon of an inch and a half in length. And this tendon is, in its origin, closely united with that of the semitendinosus for two inches, or at least the whole length of the tendon. After a short, but very thick fleshy belly, it degenerates into a tendon, especially on its back part ; and this tendon, which begins above the middle of the thigh, is continued the whole way down.

About one third down the bone is the beginning of the second or short head, which has its origin all the way down the linea aspera to the line above the outer condyle of the thigh-bone ; and here it is somewhat connected with the origin of the vastus externus muscle and the insertion of the glutæus magnus. The tendons of the two heads are joined a little above the inner condyle, and go outwards to be inserted into the outer part of the head of the fibula, forming the outer hamstring.

Its insertion surrounds the head of the fibula, and a small portion also sinks betwixt the bump of the fibula and the inner head of the tibia, to be implanted into it also.

This muscle, like the opposite ones, serves for bending the leg. The short head simply bends the leg; the long head assists the short one in bending the leg, and is also a muscle of the thigh.

The muscles of the foot are six EXTENSORS and one FLEXOR MUSCLE.

EXTENSORS.

GASTROCNEMIUS vel GEMELLUS,
GASTROCNEMIUS INTERNUS vel SOLEUS,
TIBIALIS POSTICUS,
PERONEUS LONGUS,
——— BREVIS,
PLANTARIS,
} all lying on the back part of the leg.

The FLEXOR is,

The TIBIALIS ANTICUS, lying on the fore part of the leg.

CLXXXI. The GASTROCNEMIUS is often divided into three muscles, named GASTROCNEMII or GEMELLI. But, far from counting thus, we should rather favour the arrangement of Douglas, who couples this with the next muscle, as forming a quadriceps or two muscles joined with two heads each, and he calls it the EXTENSOR CRURALIS.

The GASTROCNEMIUS is the great muscle of the brawn: its two heads are two very large and fleshy bellies, which arise from the tubercles of the thigh-bone. The inner head is the larger, and arises by a strong tendon from the back of the inner condyle, and a little way up the rough line; and it has also a strong adhesion to the capsular ligament of the knee.

The outer head is shorter than this: it arises in the same way, from the outer tubercle of the thigh-bone; and the two muscles meet and run down together, forming the appearance of a rapha, by the direction of their fibres. But the two bellies continue distinct till they meet in the middle of the leg. They are distinct at their back part, but at their fore part they are connected by a tendinous aponeurosis, or strong but flat tendon; and the two bellies being about the middle of the leg united firmly, they form a large flat tendon, very broad at its beginning, which unites with that of the soleus a little above the ankle.

CLXXXII. SOLEUS.—This name is from its resemblance to the sole-fish; and it is often named GASTROCNEMIUS INTER-

NUS. This, like the last muscle, has two HEADS, which arise from either bone.

One head arises from the bulb of the fibula, and continues to adhere to one fourth of the upper part of the bone; another head arises from about three inches of the upper part of the tibia. The first of these heads is large and round; the second is smaller and round; they unite immediately; and a large fleshy belly is formed, with still a conspicuous division betwixt the flesh of the two heads. The great tendon begins about half way down the leg, but still is intermixed with fleshy fibres till it approaches the heel. A little below the middle of the leg this tendon is united with the tendon of the gastrocnemius, to form the great back tendon, named tendo Achillis, and sometimes, though very rarely, chorda magna.

The tendon is large; it grows small as it approaches the heel; when it touches the extremity of the heel bone, it expands to take a firmer hold.

In running, walking, leaping, &c. this muscle, with the extensors of the leg, are the great muscles. The external gastrocnemius has double power; for it, arising from the tubercles of the thigh-bone, is both an extensor of the foot and a flexor of the leg; but the gastrocnemius internus is a mere extensor of the foot, and both together have such strength as often to break the tendo Achillis.

CLXXXIII. PLANTARIS.—This muscle is named from a mistaken notion of its going to the planta pedis or sole of the foot, to form the plantar aponeurosis, like the palmaris of the hand; but, in fact, it does not go to the sole, but is a mere extensor of the foot, inserted along with the tendo Achillis.

This long and slender muscle is situated under the gastrocnemius internus. It arises from the external condyle of the femur wholly fleshy; it also has an attachment to the capsular ligament of the joint; after an oblique fleshy belly of about three inches, it forms its small flat tendon. The tendon runs betwixt the inner head of the gastrocnemius and the soleus; and where the tendo Achillis begins, the tendon of the plantaris attaches itself to the inner edge and fore part of the Achillis tendon; it accompanies it down to the heel, running in a groove which seems made to receive it; and is implanted with the tendo Achillis into the inner side of the heel-bone. It is often wanting.

The use of this muscle is to tuck up the capsule in the great bendings of the knee-joint, and to assist the gastrocnemii muscles.

The PERONÆI muscles are those which arise from the fibula. They are named from their length being different: the PERO-

NÆUS LONGUS being as long again as the BREVIS ; for it is one half longer in its origin, the one rising at the head, the other at the middle of the bone ; and again it is one half longer at its insertion, going fully round under the foot of the opposite side, while the shorter peronæus stops at the side of the foot to be inserted.

CLXXXIV. The PERONÆUS LONGUS is so named from its lying along the fibula. It arises partly tendinous, chiefly fleshy, from the upper knob of the fibula, and from the ridge of the bone, down to within three inches of the ankle. It has another small slip of a head from the upper part of the tibia, above where the fibula joins ; it has also adhesions to the tendinous partition, which separates this from the EXTENSOR DIGITORUM COMMUNIS and the SOLEUS.

Its tendon begins very high above the middle of the leg ; and it continues to receive the fleshy fibres almost at right angles in the penniform manner. The tendon is concealed down to about or below the middle of the leg : then it is seen immediately under the integuments ; and we can easily distinguish it through the skin, being that acute line or string which runs down behind the outer ankle, and which gives shape to that part.

In passing the outer ankle, it runs down through a cartilaginous pulley or annular ligament, which also transmits the peronæus brevis : it leaves the peronæus brevis on the side of the foot ; and passing by itself in a groove of the heel-bone, it bends obliquely across the arch of the foot, goes quite down to the opposite side, and is inserted into the metatarsal bone of the great toe, and the great cuneiform bone on which it is founded. Under the eminence of the OS CUBOIDES it suffers great friction, so as to be thickened to a degree of ossification, and to resemble a sesamoid bone. It is also thickened in a lesser degree as it passes the outer ankle ; and in all this length it is tied down by a strong ligamentous expansion.

It is a powerful extensor of the leg ; it also gives that obliquity of the foot, which is so handsome and natural, and useful in walking. This muscle particularly turns down to the ground the inner edge of the foot ; so it presses to the ground the ball of the great toe ; and that is the part which touches the ground, and which feels sore after long walking or violent leaping or running : it is by that part that we push in making a step ; so that this muscle is perceived to be continually active in all motions of walking, leaping, running, and more particularly in dancing.

CLXXXV The PERONÆUS BREVIS is like its fellow except in length and insertion. Its origin is from the ridge of the fibu-

la; beginning about one third down the bone, and continuing its adhesion the whole way to the ankle. It also has adhesions to the tendinous partition which is betwixt it and the common extensor; so that these two muscles are by such adhesions very difficult to dissect. It is smaller at its origin, but increases in its fleshy belly as it descends; and it is fleshy lower down than the peronæus longus. It is like it, a penniform muscle.—The tendons of the two peronæi pass together by the outer ankle in the same ring: but the tendons cross each other; for the peronæus longus is in its belly more forward. The brevis lies under, and behind it, quite covered by it; and yet the tendon of the brevis, by creeping under the longus, gets before it, just under the outer ankle; and from that it runs in a separate groove, superficially, upon the outer edge of the foot, to be inserted into the metatarsal bone of the little toe. In both muscles the tendon is upon the outer edge, and begins almost as high as the upper head of each muscle. This tendon of the peronæus brevis is the shorter one, is small where it passes through the pulley, and expands when it reaches its insertion, that it may grasp the metatarsal bone firmly. The tendon of the longer muscle also expands a little, and somewhat in the form of a hand and fingers, taking hold of two bones by three little heads.

This muscle assists the former in extending the foot and coincides well in its oblique action with the last; for as the last turned down the inner edge of the foot, this turns the outer edge upwards, which is exactly the same motion.

CLXXXVI. The TIBIALIS POSTICUS is a penniform muscle, very much like the two last described, only its tendon goes round the cartilaginous pulley of the inner ankle.

It is named TIBIALIS from its origin, and POSTICUS from its place.

It arises from the back part and ridge of the tibia, from the opposite part of the fibula, and from the interosseous membrane below these; and it continues its attachment to the interosseous ligament quite down to the ankle. It has also strong attachments to the surrounding tendinous partitions. Its fibres are all oblique, and go to the middle tendon, which is in the heart of the muscle. About the middle of the tibia this tendon begins to emerge from the fleshy belly; it grows gradually smaller, but still continues to receive flesh quite down to the ankle. It passes in the groove of the inner ankle, and is retained there by such a ligament as holds the peronæi. After passing the ligament, it expands in the hand-like form, to grasp the bones of the tarsus: and it is expanded much more than the peronæus; for it sends roots down among the bones both of the tarsus and

metatarsus, so as to take hold first on the lower rough part of the naviculare in passing over it. Then it is implanted into the two first metatarsal bones, then into the calcaneum, and lastly into the os cuboides; and where it passes over the os naviculare it is hardened into a sort of sesamoid bone. In short, it is implanted in the sole of the foot by a tendon like a hand, which sends down its fingers among the tarsal and metatarsal bones, to take the surest hold. This muscle pulls the foot in so as to put the toes together; and when balanced by the peronæi, it directly bends the foot.

CLXXXVII. The TIBIALIS ANTICUS crosses obliquely the fore part of the leg. It arises from the fore part and outside of the tibia. It begins just under the outer tuber, and continues its adhesion down two thirds of the bone; then the tendon begins to be formed: and this muscle, like almost all the smaller ones of the leg, adheres to the tendinous partitions, and to the fascia, with which they are covered. The tendon begins almost with the origin of the muscle; but continues covered by the flesh, and not appearing till within four inches or so of the ankle, when it begins to pass obliquely over the leg; and having completed the crossing above the ankle, it goes under the annular ligament in a peculiar ring: it runs along the side of the foot, and is implanted into the os cuneiforme internum; and a small production of the tendon goes forward to be inserted into the metatarsal bone of the great toe.

It is the only muscle which bends the foot, that is, which turns the great toe towards the leg.

MUSCLES OF THE TOES.

THE long muscles of the toes are just four, two FLEXOR and two EXTENSOR MUSCLES. The flexor muscles lie upon the tibialis posticus, or behind betwixt it and the solæus. The extensor muscles again lie under the tibialis anticus, or at least their heads are under it, and their bellies only appear from under it about the middle of the leg.

The flexor tendons follow the tendon of the tibialis posticus by the pulley of the inner ankle into the hollow of the foot.—The tendons of the extensor muscles keep with that of the tibialis anticus, and cross over the fore part or rising of the ankle, where the tibia is united with the astragalus. And in dissection we must follow these in an opposite order to that in which they are described; for next to the fore part of the solæus is, 1st, The FLEXOR POLLICIS; 2dly, The FLEXOR DIGITORUM; and 3dly, The TIBIALIS ANTICUS.

CLXXXVIII. The FLEXOR LONGUS POLLICIS is small and pointed at its origin, and arises fleshy from three fourths of the fibula to within an inch of the outer ankle. It grows thicker and larger as it descends, and adheres to the tendinous partitions of the tibialis posticus and of the peronæi. Its tendon can be seen only about an inch above the joint of the ankle. It passes down behind the inner ankle, where it is bound in a sort of annular ligament. It there passes under the heel-bone, in the arch of the foot, betwixt the bones and the abductor pollicis; it then glides into the channel made by the two heads of the flexor pollicis brevis; it then passes betwixt the two sesamoid bones at the root of the great toe; it then goes forward in a sheath, to be inserted into the last bone of the great toe; at which implantation it is enlarged.

Its office is to bend the great toe; but it is also continually useful at every step in extending the foot, or in keeping the toe firm to the ground, while the gastrocnemii raise the heel; and therefore we should not be rash in cutting away the great toe, for in it consist not the strength of the foot only but of the leg.

CLXXXIX. The FLEXOR LONGUS DIGITORUM PEDIS, is named, in addition, the PERFORANS; because, like the perforans of the hand, it runs its tendons through the split tendon of a smaller muscle, which is lodged in the sole of the foot. It is named also FLEXOR COMMUNIS; although there be less reason here, where there are no flexors for the individual toes, than in the hand, where there are separate flexors for the individual fingers.

It arises from the back part of the tibia, its whole length; that is, from the end of the poplitæal muscle, and from the septum tendinosum, by which it is divided from the tibialis anticus, which lies immediately before it; and it continues this origin from the tibia down to within three inches or so of the ankle. Its origin is not easily separated before from the tibialis posticus, nor behind from the flexor pollicis.

The tendon is not formed till very near the ankle (within two inches of it,) and the flesh still accompanies it quite down to the joint. It crosses the tendon of the tibialis posticus behind the ankle-joint, and goes forward in the groove of the os calcis, tied down by a sort of capsule or annular ligament. In the arch of the foot it crosses the tendon of the flexor pollicis, from which it receives a slip of tendon; and thus the office of either is assisted by the other, and could be wholly supplied by it; it then passes over to the middle of the sole, and growing flatter and thicker, divides into four flat tendons. These go forward, diverging till they arrive at the ends of their metatarsal bones; then they emerge from the aponeurosis plantaris,

along with the common short flexor. Now both these tendons run under a ligamentous sheath, and are included in it under the first and second bones of the toes; and having perforated the short flexor opposite to the second joint, they are finally inserted into the root of the third or last bone of each toe. These tendons, like the corresponding ones of the foot, seem to be slit with a sort of longitudinal fissure.

The proper use of this muscle is to bend all the joints of the toes, but more peculiarly the last bone; and also to extend the foot, keeping the point of the toes to the ground, consequently assisting the gastrocnemii, and all the muscles used in walking, &c.

CXC. The MASSA CARNEA JACOBI SYLVII, or PLANTÆ PEDIS, is a small body of flesh, naturally connected with the flexor longus. The massa carnea arises from the lower part of the heel-bone, in two divisions; one (the external one) tendinous, the other fleshy. It is, upon the whole, pretty nearly of a square form; it joins the tendon of the flexor longus before its division into tendons for each toe; and by the long lever that this has upon the heel-bone it must be of great assistance to the flexor. It is more generally considered in this light of a supplementary muscle; by some it is considered as a distinct muscle, and as the origin and first beginning of the lumbricales pedis.

Thus Cowper considers the massa carnea and the lumbricales as one and the same: that the massa carnea joins the tendon, covers it with its flesh, continues fleshy along the common tendon, till at the bifurcation it also parts, along with the four tendons, into four small fleshy muscles, which are called lumbricales.

Albinus, again, paints the massa carnea distinctly terminating at the common tendon, and the lumbricales as arising distinct from each of the divided tendons.

CXCI. The FLEXOR BREVIS DIGITORUM is also named the flexor sublimis or perforatus. It arises from the lower part of the heel-bone, or the bump upon which we stand. It arises by very short tendinous fibres; and being placed immediately under the plantar aponeurosis, it takes hold of it, and also of the tendinous partitions betwixt it and the two abductors of the small and of the great toe, which are on either side of it. Under the metatarsal bones it divides itself into four heads: their tendons begin earlier upon the side next the foot; they grow round; emerge from betwixt the dentations of the plantar aponeurosis; they then pass into the vagino or sheath of each toe; and on this, the first phalanx, they lie over the tendons of the long extensors. About the root of this first bone they di-

vide into two little bands, which form a split (like the perforatus of the fingers) for the passage of the long tendon.

The long tendon passes through it upon the second joint of the toe; and immediately after the perforated tendon fixes itself by the two forks to each side of the second bone or phalanx of the toe.

Its use is to bend the first and second joints of the toes, but most peculiarly the second. And the obliquity of the long flexor is exactly balanced by a corresponding obliquity of the short flexor: for the tendon of the long flexor coming round the inner circle, runs obliquely outwards to reach the toes; while the short flexor coming from the heel, which is towards the outer edge of the foot, runs in a like degree obliquely inwards, and meets the other at an acute angle near the toes.

CXCII. The LUMBRICALES must be dissected after the short flexor. They need no description, since they exactly correspond with those of the hand. They rise like them in the forks of the flexor tendons. They, like them, pass through the digitations of the aponeurosis. They pass on to the first bone of the toes, and, like the lumbricales of the hand, creep over the convexity of the bone, to be united along with the tendons of the extensors. Their insertion is always at the side of the toe next the great toe; and their use is to bend the first joint of the toes, and to draw them towards the great one, making an arch in the foot, and assisting the transversalis pedis. The FLEXOR BREVIS lies most superficially upon the sole of the foot, having its origin from the inner surface of the aponeurosis. The MASSA CARNEA lies deeper, having no origin but from the tip of the heel-bone, and being soon implanted into the tendon of the long flexor. The LUMBRICALES again rise from the tendons of the long flexor, beginning just where the massa carnea ends in it; and the LUMBRICALES are the flexores primi internodii; the SHORT MUSCLE, the flexor secundi internodii; the LONG FLEXOR, the flexor tertii internodii digitorum.

EXTENSORS OF THE TOES.

CXCIII. The EXTENSOR LONGUS DIGITORUM PEDIS is very difficult to dissect from its numerous adhesions.

It arises properly from the head of the tibia, at its outer and fore part, just under the knee; but it has also strong adhesions to the inner surface of the fascia; to the tendinous partitions betwixt it and the tibialis anticus before, and betwixt it and the peronæi behind; and also to the interosseous ligament and to

the edge of the fibula. Its small origin soon becomes thick, and is divided even from the beginning very perceptibly into three distinct portions. These soon form three round tendons, which go obliquely inwards, pass under the annular ligament of the ankle, and run in a ring of it peculiar to them and the peronæus tertius. They then traverse the two bands of the annular ligament, upon the fore part of the foot; and now they change their direction a little, and go from within outwards, and diverge towards their proper toes. There are three portions of muscles and four toes to be moved: the first portion divides its tendon into two at the joint; so that the first portion serves both the first and second toe, the second the third toe, and the third serves the fourth toe. Here the tendon of the long extensor receives four other tendons; first, of the interossæi externi; secondly, of the interossæi interni; thirdly, of the long flexor; fourthly, of the lumbricales; and these form a very large sheath, quite surrounding the toe.

These do not only, like other extensors, extend the toes, but also, by the divergence of the tendon, expand them or separate them one from another.

CXCIV. The PERONÆUS TERTIUS should have been described as a flexor of the foot, along with the tibialis anticus; but is so naturally connected with this, that it will be more easily understood now. It is often named PERONÆUS TERTIUS, sometimes NONUS VESALII, or ninth muscle of the foot.

Its origin is from the fibula, chiefly from the middle downwards; also from the interosseous membrane; and still from the tendinous partition which divides it from the peronæus brevis. Its origin is almost entirely fleshy; and it lies behind and under the extensor communis, so that it seems in its belly to be a part of that muscle. Its tendon also passes along with the tendon of the extensor communis, through the same ring of the annular ligament; and there going obliquely towards the outside or edge of the foot over the shorter extensor, it expands and covers the metatarsal bone of the little toe with an expansion, and adheres to it as a flexor of the foot; and this, as well as the tibialis and other peronæi, have an oblique insertion generally into the side of the foot; or if into the sole, it is after running over the side, as over a pulley; so that all of them tend to press down one edge, that of the ball of the great toe, to the ground.

CXCV. The EXTENSOR DIGITORUM BREVIS is so connected with the extensor longus, that it is natural to describe them together. The extensor brevis is a small mass of flesh, somewhat resembling the massa carnea and lumbricales of the foot. It is placed just where the buckle lies, upon the rising of the

foot, having its origin from the heel-bone, and running obliquely inwards.

Its origin is from the outer side and fore part of the heel-bone, and also from part of the annular ligament. It is smaller where it arises by a short tendon from the heel-bone, but it gradually increases in size: it divides early into four heads, which are muscular, and very distinct; the two inner of which are larger, the two outer more slender: each head has already formed an oblique tendon under its flesh, which begins to appear naked about half way down the metatarsal bones. These tendons cross those of the long extensor, and pass under them nearly about the end of the metatarsal bones. Then one is implanted into the first bone of the great toe, on the inside of the long tendon under which it had turned. The second, third, and fourth tendon are inserted into their respective next toes, and the little toe is left without one. The three last of these tendons form a sort of slit; the two sides of which pass along the sides of the toes, surrounding the long tendon, something like a perforatus; so that the three last tendons are inserted along with the long tendons into the last bone of the toes.

The obliquity of this short muscle counteracts the obliquity of the long; and it serves to extend and to spread the toes, and to pull them away from the great toe.

CXCVI. The EXTENSOR POLLICIS PROPRIUS is a very slender muscle, running from the top of the leg to the second joint of the great toe. It arises from the fibula a little below its head; grows tendinous as it approaches the foot; then passing under the annular ligament and the cross ligament of the foot, it goes onwards to the second joint of the toe over the first.

The succession in which these muscles lie under and behind each other is this: first, the tibialis anticus, the outermost muscle, arises from the fore part of the tibia, nearest the fore part of the leg, at the ridge of the tibia: secondly, the extensor pollicis lies immediately behind and under the tibialis anticus: thirdly, the extensor digitorum communis lies behind that: and, fourthly, the peroneus tertius lies behind the common extensor like a part of that muscle.

These extensor tendons are bound down by cross bands, resembling the annular ligaments of the wrist. The general fascia of the thigh is continued over the knee and down the leg: it is much strengthened at the knee, where it adheres to each point of bone: it descends very thick and strong over the leg, binding down and strengthening the tibialis anticus and extensor muscles. The sheath grows thinner towards the

ankle ; but where it passes over the joint, it is so remarkably strengthened by its adhesions to the outer and inner ankles, that it seems to form two distinct cross bands, which, going from the point of the outer ankle across the extensor tendons to the point of the inner ankle, forms a strong crucial ligament, resembling the annular ligament of the wrist ; so that this which is called the CRUCIAL LIGAMENT of the ankle or foot, is plainly but a strengthening of the common sheath.

The muscles of the foot are the INTEROSSEI, which, in the foot, are found single on the lower surface or sole, but double and two-headed upon the upper part of the foot. The ABDUCTOR, FLEXOR, and ADDUCTOR POLLICIS, which surround the great toe, something like those of the thumb ; and the ABDUCTOR and FLEXOR MINIMI DIGITI, surrounding the little toe ; and there is a small slip of muscle, the TRANSVERSALIS PEDIS, which goes across the sole of the foot.

CXCVII. The ABDUCTOR POLLICIS arises by very short tendinous fibres from the knob of the os calcis, and also from a ligament which stretches from this knob to the sheath which belongs to the tibialis posticus ; and it arises also from the tendinous partition betwixt it and the short flexor of the toes ; and although it forms a beginning tendon opposite to the cuneiform bone, the tendon is not naked till it has reached the middle of the long metatarsal bone. It unites with the short flexor of the same toe, and is inserted into the first bone or phalanx of the toe at its root. Its use is to pull aside the toe, and at the same time to bend it a little ; it also curves the foot itself ; for a joint, or any loaded part, is much better supported by muscles than by ligaments ; and this arch requires support more than almost any other part.

CXCVIII. FLEXOR BREVIS POLLICIS. This muscle is much shorter than the last, and lies betwixt the ABDUCTOR and the ADDUCTOR : it lies immediately upon the metatarsal bone.

Its origin is by a pretty long tendon from the heel-bone, and from the OS CUNEIFORME EXTERNUM, by two separate slips, from the heel-bone, being a full inch in length ; it also adheres to the membranous partitions on either side of it. It is soon divided into two heads : one goes to the abductor, and the other goes to the adductor, to have the tendons inserted with theirs into the root of the first bone or phalanx. These tendons contain the sesamoid bones ; and the parting of the two heads makes a channel for the tendon of the long flexor to run in.

Its use is to bend the first joint of the great toe.

CXCIX. The ADDUCTOR POLLICIS is the third and last portion of the muscle which encircles the great toe.

It arises from the heel-bone by a tendon as long almost as that which it gives the abductor: it does not immediately arise from the heel-bone; but there is a ligament extended from the heel-bone to the os cuboides, and it arises from that ligament: this is the ligament under which the tendon of the peroneus longus glides. The adductor is divided into two fleshy fasciculi or heads; these unite, and, going obliquely inwards, are inserted either into the sesamoid bone, or directly into the first bone of the great toe.

CC. The TRANSVERSALIS PEDIS extends transversely across the sole of the foot at the head of the metatarsal bones; it is a very small muscle, and resembles a good deal the palmaris brevis.

It arises from the ligament which connects the bones of the tarsus together; and a small muscular belly is formed, which is inserted into the tendon of the ADDUCTOR POLLICIS.

Its use is said to be to make a sort of gutter in the foot, by drawing the heads of the metatarsal bones together. But is it not evident that this is one of many instances of muscles being a more perfect support than ligaments?—It is a support, having a sort of intelligence, contracting or relaxing according to the necessity or degree of force: indeed, except this use, it is not easy to assign any; for there is very little occasion for hollowing the foot in this direction.

CCI. The ABDUCTOR MINIMI DIGITI, like the abductor pollicis, is a pretty long muscle, but very slender, lying on the outer side of the foot.

Its origin is from the knob of the heel-bone, and from the tendinous septum, which covers the flexor brevis: it forms two small tendons in the same direction; one small and shorter tendon is fixed into the metatarsal bone, at its root; the other goes forward, to be inserted into the root of the first bone of the toe: so that this muscle clearly performs both the offices ascribed to the other flexors. It bends the toe to which it belongs, and it extends and supports the tarsus in walking; and it carries the toe a little outwards, from which it has its name.

CCII. The FLEXOR BREVIS MINIMI DIGITI is next, and is almost the same muscle in place and office: it is an exceedingly small muscle; it just measures the length of the metatarsal bone, and arises from it. Its origin is from the root of the metatarsal bone of the little toe, and from the ligament by which that bone is connected with the os cuboides; its small belly runs the length of that bone; and it is implanted by a short tendon into the root of the first bone of the little toe.

Its use is to bend the toe.

CCIII. The INTEROSSEI INTERNI are three small muscles

seated in the planta pedis, as the interossei manus are in the palm of the hand. Their slender tendons pass through the openings of the aponeurosis plantaris ; and, going on the inside of the toes, are, like the lumbricales, inserted along with the extensor tendons.

These pull the toes towards the great toe, bend the first joint, and extend the second and third.

CCIV. The INTEROSSEI EXTERNI are, like the corresponding muscles of the hand, four in number, and double headed, and have been named bicipites. They rise from the metatarsal bones on each side of them : each has some little variety in its origin or course ; but it is far from being worth our while to describe each individually, as many do : it is sufficient to observe their origin, and that their tendons all meet the tendons of the long and short extensors of the LUMBRICALES, and of the INTEROSSEI INTERNI, upon the back of the toes ; so that the whole forms a web, aponeurosis, or sheath, which covers the upper part of the toe, and adheres to its point.

The office of these muscles is to extend the toes.

PLANTAR APONEUROSIS.—The palm and the sole are much exposed, and are specially defended by a thick tendinous aponeurosis. In the palm there is the more reason to suspect expansion to proceed from the tendon of the muscle, because the tendon of the palmaris is inserted into it : yet that is not probable ; for the tendon is very slender, and quite unfit for the generation of so broad a sheet of aponeurosis. In the foot such an origin is still less probable ; for the plantaris tendon does not terminate in the plantar aponeurosis, but is inserted into the heel-bone.

The plantar aponeurosis arises most distinctly from that part of the tuber of the heel-bone upon which we stand : it is divided into three sheaths. Sabbatier makes a middle, external, and internal portion of the same aponeurosis. Albinus also describes it as three distinct aponeuroses : one for the middle of the foot ; one for the abductor of the great toe ; and one the aponeurosis of the abductor of the little toe ; all connected together only by their edges. Cowper considers it as a general expansion from the plantaris ; and it is from this prejudice that the muscle has its name.

But its true origin is from that part of the knob of the heel-bone on which we stand. The middle, and more pointed tendon, arises from the very point of the knob ; the inner fascia arises from the inside of this ; and the outer one from the outside. And though thus divided into three heads, yet the whole origin is from the heel-bone, and is small and pointed. From this point the aponeurosis goes forward, expanding till it is as

broad as the roots of the toes ; so that the whole has the shape of a sandal ; and as it expands, its fibres are more scattered, so as to have a radiated appearance. Accordingly, the part nearest the heel is thicker, while the broader part is thinner.

It goes forward, like the sole of a shoe, till, having approached the heads of the metatarsal bones, it is divided into five heads, corresponding with the five knobs : and each of these heads again subdivides itself into two bands ; which, passing on each side of the heads of the metatarsal bones, is fixed into the sides, so as to leave room for the passing of the tendons, and nerves, and arteries.

Now, this middle aponeurosis sends down a deep strong partition on each side of it ; which is the best reason that I know for making these three distinct aponeuroses : for, by these perpendicular partitions, the hollow of the foot is separated into three distinct chambers : under the middle one are concealed the tendons of the long flexors, with the lumbricales and short flexor muscles ; under the outer one, the flexor and abductor of the little finger : and under the inner one, the adductor, flexor, and abductor of the great toe.

The uses of this great and very strong aponeurosis are : that it protects all the parts, the blood-vessels, muscles, and nerves that lie under it : that it supports the arch of the foot, both in standing and in motion, passing from heel to toe, like a bow-string, across its arch : that it binds down the muscles, and consequently supports and assists them in their strong actions : that it gives origin, or part of their origin to many of the muscles ; which, by their frequent and irregular adhesion to it, are very difficult to dissect : that it forms openings or rings, in which the tendons of the other muscles pass.

CHAP. IX.

OF THE MUSCULAR POWER.

THAT contractile power which resides in the muscular or living fibre, is a phenomenon the most wonderful and perplexing of all. When we cannot reach the true point, the mind too often condescends to the most trifling pursuits : and so, when

the older physiologists could not understand the intrinsic nature of this muscular power, they endeavoured to discover the size, the colour, and other external properties of the fibre; foolishly desiring to know what, if known, could be of no avail. Colour was believed to be essential to the constitution of a muscle: but in fowls, in amphibious animals, in fishes, in worms, and insects, through all the gradations of animals, of different species or different sizes, the colours of the muscular fibre change. In fishes and in insects it is entirely white; even in the human body it is not essentially red; the fibres of the iris, the muscular coats of the arteries, the muscles of the stomach, of the intestines, and of the urinary bladder, are colourless: the blood which makes this fibre red in the other parts may be washed away. Then why should we define a muscle by that accidental property which it so often wants, and of which it may be so easily deprived; while we may define it more truly by its contractile power, the only evidence of its nature, and its chief distinction in the system? for the contraction of the iris constitutes its nature; it is a muscle by truer marks than by its colour: and, by the same rule, the muscles of the least insect are as perfect as the muscles of a man.

Philosophers of the last age had been at infinite pains to find the ultimate fibre of muscles, thinking to discover its properties in its form; but they saw just in proportion to the glasses which they used, or to their practice and skill in that art, which is now almost forsaken. Some found the fibres to be of one equal size in all creatures, however various: others found them proportioned to the size, or age, or strength, of their subject: but even such discrepancies are trivial to those which, in one of the greatest of these minute philosophers, are found almost in the same page; sometimes affirming the ultimate fibre to be greater or smaller, according to the strength of the subject, and again making them of equal size in the whale and in the insect.

Others, less troubled about the ultimate size of these fibres, have conceived notions of their form, which, in the credulity of the times, rose into the importance of doctrines; and, from the first raw conceptions of their authors, were finally proved by the microscope forsooth; and while one author was drawing his rhomboidal fibres all conjoined in regular succession, and another describing them also from the microscope as consisting of six cylindrical fibres involved in a spiral one, a third reckoned the fibres a succession of spherical bodies; and Cowper thought that he was injecting with quicksilver chains of bells jointed with each other. For the honour of the age, these vanities are forgotten now. And why, indeed, should we seek

the ultimate fibres of the muscle, or study their forms, when the discovery could not advance us one single step in the knowledge of its nature or essence? What avails it, that we have discovered (if we have really discovered) the shape of the particles of the blood; the wave-like fibres within the substance of the nerves; or the jointed appearance in the smaller fibres of muscles? We do not understand the nature of the blood, the properties of the nerves, nor the contractile power of the muscles, at all better by the knowledge of this peculiar form of the internal structure, than we do by the grosser marks of their external form.

Physiologists have, by a late sense of their own weakness, been at last humbled to this becoming, but unwilling acknowledgment, that this contractility of the muscles is an original endowment of this living matter derived from the Creator; imparted in a way which we cannot know; and so attached to the organization of the muscular fibre, that when its organization is destroyed, this power is lost. We have resigned the search after a mechanical or physical cause, and seek only to learn the properties of this living power, and the excitements by which it is moved. To this end it is necessary to define this power, distinguishing it from those feelings or motions which result from the nerves. The vis insita being that power which belongs to muscles, is the source of motion and animal life. The vis nervea, being that property which is peculiar to nerves, is the seat of feeling, and the cause of voluntary motion, relating chiefly to the enjoyments and consciousness of life; for life and motion exist even in plants, and in many creatures which, not having nerves, have neither consciousness nor enjoyment, and in which the place of feeling is supplied by a less perfect instinct by this vis insita, or some analogous inherent power.

This irritable power residing in muscles may be defined the property by which muscles feel and re-act, upon certain stimuli being applied, without that feeling being conveyed to the sensorium; without a consciousness of action; without any other natural dependence on the system than that while certain orders of muscles are obedient to their own stimuli only, as the heart to the blood, other orders of the muscles are ready to receive the commands of the will. And above all, so little dependent is this action upon the nerves, that it is as perfect in animals which have no nerves; and is for a time very perfect in the parts which have been severed from the systems to which they belonged. This power, inherent in the muscular fibre, belonging to its constitution, and not derived from without, is

the vis insita or irritability of Haller*, the vis vitalis of Goerter, the oscillation of Boerhaave, and the tonic power of Stahl. It is seen in the spontaneous and tremulous contractions of muscles when lacerated, as in wounds; when cut in operations; when entirely separated from the body, as in experiments upon animals; like that tremulous motion which we often feel in various parts of the body, without any evident cause, and independent of the will. Even when the body is dead to all appearance, and the nervous power gone, this contractile power remains; so that if a body be placed in certain attitudes before it be cold, its muscles will contract, and it will be fixed in that posture till the organization yields and begins to be dissolved. It is by this inherent power that a cut muscle contracts and leaves a gap; that a cut artery shrinks and retires into the flesh; that the whole body shrinks and grows stiff after death. These are but faint indications of that latent power which can be easily excited to the most violent motions, and on which all the strength of the muscles depends: for the ligaments, tendons, bursæ of joints, and all those parts which have no living power, are capable of bearing the same weight when dead as when alive. But such is the connection betwixt the organization of a muscle and its contractile power, that the moment it dies all its power is gone; and the muscle which could lift a hundred pounds while alive, cannot bear the weight of a few pounds when dead. This latent power may be brought into full action by various stimuli. The latent power itself is called vis insita; the acting power put into action, or the proof of the vis insita, upon applying stimuli, is called the irritability of muscles. This irritability is so far independent of nerves, and so little connected with feeling, which is the province of the nerves, that upon stimulating any muscle by touching it with a caustic, or irritating with a sharp point, or driving the electric spark through it, or exciting with the metallic conductors, as of silver and zinc†, the muscle instantly contracts; although the nerve of that muscle be tied; although the nerve be cut so as to separate the muscle entirely from all connection with the system; although the muscle itself be se-

* The irritability of a muscle is, perhaps, more properly the vis insita or inherent power called into immediate action by the presence of stimuli: and as for the names of Tonic Power, Vital Power, and the rest, the terms are quite undefined, and may perhaps have referred rather to the combined effect of all the powers of life, and of all the properties of inanimate matter, of nervous sympathy, elasticity, and of muscular power combined.

† See a most ingenious dissertation by my pupil Mr. Fowler, the first writer, in this country, on this very interesting novelty, where the operations of this new excitement are explained.

parated from the body ; although the creature upon which the experiment is performed may have lost all sense of feeling, and have been long apparently dead. Thus a muscle cut from the limb trembles and palpitates for long after ; the heart separated from the body contracts when irritated ; the bowels, when torn from the body, continue their peristaltic motion, so as to roll upon the table, ceasing to answer to stimuli only when they become stiff and cold ; and too often in the human body the vis insita loses the exciting power of the nerves, and then palsy ensues ; or, losing all governance of the nerves, the vis insita, acting without this regulating power, falls into partial and general convulsions. Even in vegetables, as in the sensitive plant, this contractile power lives. Thence comes the distinction betwixt the irritability of muscles and the sensibility of nerves ; for the irritability of muscles survives the animal, as when it is active after death ; survives the life of the part, or the feelings of the whole system, as in universal palsy, where the vital motions continue entire and perfect, and where the muscles, though not obedient to the will, are subject to irregular and violent actions ; and it survives the connection with the rest of the system, as where animals very tenacious of life are cut into parts :—but sensibility, the property of the nerves, gives the various modifications of sense, as vision, hearing, and the rest ; gives also the general sense of pleasure or pain, and makes the system, according to its various conditions, feel vigorous and healthy, or weary and low. And thus the eye feels, and the skin feels ; but their appointed stimuli produce no motions in these parts ; they are sensible but not irritable. The heart, the intestines, the urinary bladder, and all the muscles of voluntary motion, answer to stimuli with a quick and forcible contraction ; and yet they hardly feel the stimuli by which these contractions are produced, or at least they do not convey that feeling to the brain. There is no consciousness of present stimulus in those parts which are called into action by the impulse of the nerves, and at the command of the will ; so that muscular parts have all the irritability of the system, with but little feeling, and that little owing to the nerves which enter into their substance ; while nerves have all the sensibility of the system, but no motion.

The VIS INSITA is a power that is in continual force, preserving the parts ready for their proper stimuli, whatever these may be ; one set obeying their own peculiar stimuli chiefly ; while others are obedient to the nervous power and the influence of the will. The heart is stimulated by the quantity or quality of its blood ; the stomach by the presence of food ; the intestines by their contents : the urine stimulates the bladder ;

the venereal appetite stimulates the genital system ; the fœtus stimulates the womb ; and the voluntary muscles (if we may be allowed to guess at a thing so little known) are excited by the nerves, and so are obedient to the will ; for, to our limited view, the nerves seem to be the sole messengers of these commands ; and any stimulus to the nerves moves the muscles like the commands of the will. The absence of the due stimulus to each, or the presence of ordinary stimuli in too great power, will excite enormous and irregular motions ; as fulness of blood in the heart, poisons in the stomach, acrimonies in the intestinal canal, or the passions of anger or fear in the system of the voluntary muscles. The due stimuli preserve their right tone and action ; but these violent stimuli hurt their irritability or moving power ; the heart acts weakly after fevers ; the appetite is languid after debauch ; the limbs are weakened by labour ; and the whole system is ruined by excess. Thus the functions by which the system lives, the heart, the stomach, the bowels, and the womb, the various sorts of vessels by which the fluids are conveyed, are providently removed from the influence of the will ; for these are the machines of the system, whose motions could not stop, must not be interrupted, nor lowered, nor raised, but must move and act according to the needs of the system. Not left to the irregularities or carelessness of voluntary motions, they are governed each by its own peculiar stimulus, and act in a continued and equal course.

Thus there are in the body two living powers which are as cause and effect in all motions of our system. The NERVES stand as an intermedium betwixt all external objects and our general sense ; by the impressions through these come pleasure and pain, and all the motives to action ; by the will, returned through the nerves, all voluntary motions ensue. Thus are the nerves, as internuncii, betwixt the external impression and the moving power. But nerves were never known to move under the influence of stimuli ; the moving power is another property of a distinct part of our body, having its own arrangement of particles, and its own peculiar form. All motion then proceeds from the joint operation of either power ; the nerves convey the impressions, while the muscles contain the power ; and it is here, as in other natural effects, the external cause changes, while the inherent property, the subject of its operation, remains the same. The nervous power is the regulator of the system; it is the property suited to all the supports of life, upon which they act, and by which they maintain their power over our body : but it is subject to continual changing ; it rises and falls, is perfect or low ; but the energy of the muscle, which is to answer to this power, remains ever the same while its organ-

ization remains; the nervous power is exhausted and languid; but the muscular power is always perfect, always ready for the excitement of stimuli or for the commands of the will.

There is (if we may be allowed any expression so loose and indefinite) the will of the system, and the will of the mind: it is the will of the system that, through the medium of nerves of wide sympathy and consent, governs and leads in harmony all the consenting functions of the body, and lowers and raises their powers, according to the weakness, or strength, or fulness, or wants of the body; while the will of the mind commands those voluntary motions, which it is its choice to perform. So natural seems that notion which has long prevailed of an archæus, or presiding spirit, which, like a latent instinct, regulates and preserves the system, prompts to what is right, and creates an aversion to what is wrong, and raises or allays the actions of the vital organs, preserving the system in health, and striving against disease. The voluntary muscles are put under the command of the will, while the involuntary muscles, by which the vital organs move, are insulated and mechanical, and depend less on our spiritual part; for life and existence depend less on feeling, or that which is allied to our spiritual part, and more on the irritable or moving power; and it was fit that this irritable power should be divided from our feelings and our will, which are irregular and transitory, and apt rather to derange than to preserve the system.

How this division is accomplished we do not know in any surer way; but we see that the heart, the lungs, the stomach, and the intestines, have a proportion of nerves, so much lower than the muscles of voluntary motions, that the very existence of these nerves has been denied. Yet there are nerves proper to the vital parts: the phrenic nerve goes to the diaphragm; the par vagum to the stomach and bowels; the sympathetic nerve to the heart: they are smaller, but they are appropriated and distinct. Now this question occurs: if the irritable power be in these organs, if they be endowed with the quality of feeling their own peculiar stimuli, and answering to their impulses, what need is there for nerves? But they also have their nerves, that they may not want some living connection with that system to which they belong; that they may flourish in its health, and languish in its diseases; that they may act according to the needs, and be subject to the will of the system; that the grand movers of the mechanical system may be affected in their turns by the spiritual part, and thus the digestion, the circulation, the venereal appetite, and every vital power are languid and depressed, or lively and perfect, according to the conditions of the whole: and how these functions are moved by anger, or

joy, or fear, needs not be told. But the vital functions also lose their action: "The heart acts weakly after fevers; the appetite is languid after a debauch; the limbs are weakened by labour; and the whole system is ruined by excess." These organs have less dependence on nerves; and so suspicions arise, that the irritable power, the very basis of life, may also fail: but how should it fail? If the motions of our system cease, it must be either from the incapacity of the muscles, or from the loss of exciting power in the nerves. The nerves are liable to change, but the muscle retains its power till its organization be destroyed. When the irritable power of a muscle ceases, when the heart, for instance, begins to fail, whence can that loss arise? Its power is not mechanically exhausted, else from what source could it ever be renewed? It is not from any injury to its nerves: for the heart, when cut out from the body, may be wearied out with constant stimuli till it cease to act; and it will recover by rest, without communication with the nerves: but it is perhaps such a derangement as happens in a spring, which, being long bent, loses of its elastic power: the arrangement of its particles suffers by straining; they are composed by rest: and if the elastic power be thus restored in an inanimate spring, much more should the contractile power recover by rest in the muscular fibres of a living system.

The VIS INSITA cannot be wearied nor exhausted; so the heart is unwearied in its function, or if languid or too violent in its actions, that must be from the power of stimulus being lowered or increased, not from any change on the inherent power. The voluntary muscles also are unwearied; and so, after great fatigue, we are sensible of cramps and irregular contractions, showing that they are still active, but more loosely governed by the nerves, and not so fully under the command of the will. But the NERVOUS SYSTEM is more subject to weariness and to decay: the senses become tired; the feelings of the system are exhausted. It is from this failing of the nervous power that violent exertions bring fatigue and pain; from this also that we need the refreshment of sleep; but during sleep, the heart, and all the involuntary muscles, unwearied in their functions, proceed still in the same regular and orderly course.

This irritability or inherent power not only keeps the muscles ready, each for its peculiar stimulus, but preserves a balance over the whole system of the muscles. We know that muscles maintain a constant action independent of the nerves. The muscles of one side balance the opposite muscles: and if the muscles of one side be relaxed by palsy, the action of the opposite muscles instantly appears: or if a limb be luxated, and

its muscles displaced, they persevere in a violent and spasmodic action till they be restored each to its place. Have we not reason to believe, that if muscles were absolutely and entirely quiescent, they could not be so instantaneously called into action ; but that by this continual tension or tone they more readily follow the commands of the will : that by this lesser tension they are prepared for greater action, and inclined to harmonize : for if all the muscles were quiescent, and one suddenly moved by the will, its antagonist would rise into undue action, and the co-operating or assisting muscles would be unprepared. Whereas, by this continual tension of all the muscles, one set is opposed to another, is consenting with it, and is ready to co-operate with it, or to oppose it in the due degree : the mind has but to incline the power towards one set, and immediate and orderly motions ensue.

The NERVOUS INFLUENCE, again, is as a mere stimulus to the voluntary muscles, as blood is to the heart, or the fœtus, or any foreign body, to the womb. It loses its influence over the system faster than the ordinary powers of life do ; and the irritable state of the muscles continues long after the voluntary motion, or the power of excitement from the nerves, is gone : for when we die slowly this inherent power is exhausted in the struggles for life. If, while in perfect health, we are killed by a sudden blow, the irritable power of the muscles survives the nervous system many hours or days, and the flesh trembles, and the absorbents continue to absorb ; and often, as after suffocation, we can, by operating upon this poor remains of life, restore the circulation, re-animate the nervous system, and recover that life which seemed to have entirely left the body ; and thus the nervous influence, which seemed to animate the system, and to be the prime mover and source of life, owes its restoration to that which was thought to be but a secondary power. It is this remains of contractile power which fixes the dead body in whatever posture it is placed : it is this remains of irritability which preserves freshness in the animal which seemed dead, but which is really dying still : for the moment this lingering portion of life is gone, the body dissolves, and falls down ; and so we judge of freshness by the rigidity of the flesh, and foresee approaching putrefaction by its becoming soft. There is no putrefaction in creatures suddenly killed, as in the accidents which happen to man, or in killing animals by a sudden blow ; in these the body continues fresh and susceptible of stimuli long after death : but if this inherent power, this irritable nature of the fibre, be exhausted before death, or in the moment of death, then does the body fall quickly into the condition of dead matter, running through those changes which are

the only true marks of death. The fish, which is allowed to struggle till it be dead; the ox, over-driven before it be brought to the slaughter; the animal killed by lightning, which suddenly explodes (if we may be allowed the expression) all the powers of life—in these the contractile power is effectually exhausted; no mark of irritability remains; putrefaction comes quickly on: and so in those who die of the plague, of poison, of fevers, or of any sudden and violent disease, which at once extinguishes life, in the vulgar sense, and robs the system of that remnant of life which the physiologist could produce to view; in all these cases, the body becomes putrid in a few hours. If a body becomes putrid so early in warm climates, it is not merely because putrefaction is favoured by heat; but it is because heat exhausts the vital power, and often a part of the body has lost its organized power, and is almost putrid, before the whole be dead. We find that we are wrong in this, that when a body has lost all feeling and motion, we pronounce it dead; the nerves indeed have ceased to do their office; all feeling and consciousness is gone; but the mere animal power survives the nerves, and through it the whole system may be re-called into perfect life.

The powers and privileges of the nervous system must not be ranked too high nor valued too low: the perfect animal feels and moves by the nervous power; but surely its muscles are actuated by a law of their own nature: the heart of the chick begins to move before we dare presume that there is any organ for distributing this nervous power. The punctum saliens is the heart of the chick; it is seen beating while the body of the chick is but a rude, unformed, and gelatinous mass; daily this active centre increases in strength and power; and it has a delicate feeling of stimuli, and it quickly re-acts, so as "to fly out into angry and perturbed motions" by the application of a stimulus. It is excited by increased heat, and languishes when cold, till at last it dies; then it ceases to act, but still heat restores it to life: and is not the proof stronger in the grown animal, when we cut out the heart, which answers to stimuli for some time; at last seems to have its power exhausted; it lies dead for some time, till it again recovers its power. If this power proceeded from the nerves, how could it be renewed? but if it reside in the muscle only, it may have been wearied, and may revive: its organization may have been deranged, and may be restored by rest from stimuli; and its parts may be composed again, resuming their relative situation, and their active arrangement and form; or though it may be insensible to a stimulus long applied, it may be still alive, even to a lower stimulus of another kind; or it may awake again to the feeling

of that stimulus, which, by being too long applied, had lost its power.

Sensibility depends upon the nerves; motion on the muscles; both are equally admirable and inscrutible; the one conducing to all the enjoyments, and all the sufferings of life, and to the intellectual faculties of man; the other being the chief support of animal life, and the source of all the bodily powers.

As for the MECHANICAL POWERS, by which the contraction of the muscular fibre is forwarded or retarded, they are not what they have been believed; for we find few circumstances in the origin, insertion, or forms of muscles, to favour their power, but many by which their power is abridged. There are certain points where the length of lever gives an increase of power. The mastoid process, and the occiput, are as levers for the head; the spines of the vertebræ, for the back; the olecranon, for the arm; and the pisiform bone, for the hand. The pelvis and the jutting trochanters, are as levers for the thigh; the patella is a lever for the leg; the heel-bone is a lever for the whole foot; and the arch of the foot is as a lever for the toes. These are not the whole, but they are perhaps the chief levers in the human body. In all the other implantations the muscle is fixed, not behind the joint, but betwixt the joint and the weight that is to be moved. There is a greater loss of power when inserted near to the joint; there is less loss of power when the tendon is inserted far from the joint; and though we call such insertion a longer or shorter lever, there is always some loss of power, and the true levers in the body are very few.—Far from providing mechanical forms to increase the power, nature has provided such a quantity of contractile power as to compensate for any loss of effect: so, in place of increasing the effect of muscles by levers, pulleys, and hinges, there is in almost every muscle a great abatement of its force by the form of the bones which it is destined to move; for muscles lose of their effect by their being implanted, not behind the joint, but betwixt the joint and the body to be moved; by the insertion of almost all muscles being very oblique, with respect to the motions which they are to perform; so that half their force is lost upon the immoveable end of the bone. Much force is lost by a muscle passing over many joints: one set of fibres in a muscle hinders the action of adjoining fibres, and every degree of contraction takes from that muscle an equal proportion of its power. Thus, every where in the human body, is power sacrificed to the form and fitness of the part; that the joints may be smaller than the limbs; that the limbs may be proportioned to the body: and beauty and conveniency is gained by the sacrifice of that power which is not needed in the system.

since the wisdom and goodness of the Creator has appointed a degree of force in the muscles more than proportioned to all this loss of the mechanical power. Those who will admire the ways of Providence, should know how to admire! Nature is not seeking to compensate for want of power, by the advantages of pulleys, and levers, and mechanical helps; nor is it in the forms of the parts that the Infinite Wisdom is to be found; for among other gifts, such a portion of this spirit is given to man that he has used the pulleys, and levers, accelerations of motion, and all the mechanical powers that result from it; he has invented valves of infinite variety, each perfect and true to its particular office; he has anticipated all that he has found in the mechanism of the human body; but the living power which compensates for the want of levers, which allows every where power to be sacrificed to the beauty of form, which has strength in convulsive and violent actions to break the very bones; this is the act of Infinite Wisdom, on which our admiration should chiefly dwell.

It is but the very elements of so deep a subject that can be delivered here. I must proceed to explain those provisions for easy motion, which may be considered as belonging to the muscles and bones, and as preparing us for a knowledge of the joints.

CHAP. X.

OF THE TENDONS, LIGAMENTS, BURSÆ, AND ALL THE PARTS WHICH BELONG TO THE BONES OR MUSCLES, OR WHICH ENTER INTO THE CONSTITUTION OF A JOINT.

THE bones and muscles themselves are but the smallest part of that beautiful mechanism by which the motions of the human body are performed; for the parts by which the bones are joined to each other, or the muscles fixed into the bones, are so changed and varied in their forms, according to the uses of each part, as to give a natural and easy shape to the limbs, security and firmness to their motions, and lubricity and smoothness to the joints by which these motions are performed: and this apparatus deserves our attention, not merely that we may

know the forms of these joinings, but that we may learn something of the nature and uses of each part, and the various degrees of sensibility with which each is endowed; for from this kind of study conclusions will arise which may lead us to the knowledge of their diseases, suggesting the means of their prevention and cure.

There is a difference in the parts of the human body, according to the several uses for which they are designed; some are vascular and soft, others bony and hard; some sensible, and very prone to inflammation and disease, others callous and insensible, having little action in their natural state, and little proneness to disease. The greater part of the human body is merely inanimate matter, united into a moving and perfect whole, by the system of the nerves which abound in each creature according to its wants, and are distributed in each system according to the uses and functions of every part. In some places there is such a conflux of nerves as form the most delicate and perfect sense, endowing that part with the fullest life; while others are left without nerves, almost inanimate and dead; lest feeling, where it ought not to be, should derange the whole system.

The living parts of the system are the muscles and nerves; the muscles to move the body, and perform its offices, each muscle answering to its particular stimuli, and most of them obeying the commands of the will; the nerves to feel, to suffer, and to enjoy, to issue the commands of the will, and to move the muscles to action: but still the muscles have their own peculiar kind of life, superior to the nerves, and independent of them, always acting, always capable of greater action, always ready to receive the impulse of the nerves. It is a power which survives that of the nerves, acting even when severed from the general system; and acting often on the living body without the impulse of the nerves, and sometimes in opposition to the will. The dead matter of the system joins these living parts, and performs for them every subservient office; forms coverings for the brain; coats for the nerves; sheaths for the muscles and tendons; ligaments and bursæ; and all the apparatus for the joints; unites them into one whole by a continued tissue of cellular substance, which from part to part through all its various forms, has no interruption, and suffers no change, but still preserves its own inanimate nature, while it joins the living parts to each other. The tendons, ligaments, periosteum, and bursæ, are all composed of this cellular substance, which by its elasticity binds and connects the parts, and by its dead and insensible nature is less ex-

posed to disease, and is a fitter medium of connection for the living system.

OF THE FORMS OF THE CELLULAR SUBSTANCE.

UNDER various modifications and shapes this dead matter performs most important offices among the living parts :—1. It forms CELLS over all the body, which allow the parts to glide and move easily ; which contain the fluid that makes all the motion of parts more easy and free ; which store up fat to fill the interstices, to support the parts in their action, to give a plumpness to all the body, and to be reabsorbed for the needs and uses of the system. This cellular substance is peculiarly useful to the muscles; dives in among them ; keeps their fibres at such due distance that each may have its action ; supports and lubricates them ; so that perhaps the difference of strength, in health and disease, depends, at least in some degree, upon this support. The thinner halitus makes the play of the fibres easy and free ; and the fat not only supports the fibres in their action, but lubricates them so, that a want of it is painful, while a superabundance of it incumbers the body. And Haller seems to have believed, that a diseased increase of it might not only oppress, but almost annihilate, the muscular fibre.

2. But it is still further essential to a muscle, that while it moves, it should neither be hurt itself nor harm the surrounding parts. Therefore, where one muscle moves over another muscle, soft flesh upon soft flesh like itself, there can be no hurtful friction, and the cellular substance is loose and natural, preserving its common form. But where tendons rub upon tendons, or bones upon bones, or where tendons rub upon muscles, or upon each other ; some defence is needed, and the cellular substance assumes a new form. The cells are run together into one large cell, with thicker coats, and a more copious exudation ; so that, being more liberally bedewed with a gelatinous mucus, it prevents the bad effects of friction, and is called a BURSA MUCOSA, or MUCOUS bag. These mucous bags are placed under rubbing tendons, and chiefly about the greater joints ; some are large and others small ; their glairy liquor is the same with that which bedews the cellular substance or the cavities of the joints ; and the provision of nature is so perfect, that the occasions which require bursæ seem to form them by friction out of the common cellular substance.

3. It is often useful that an individual muscle should be enclosed in a tendinous sheath, to give it strength and firmness, and to preserve it in its shape. All muscles, or almost all

muscles, form for themselves individual sheaths, such as are seen inclosing the supra-spinatus and infra-spinatus of the scapula; the biceps humeri, and most of the muscles of the leg and thigh; but it is especially necessary that the whole muscles of the limb should be inclosed in some stronger membrane than the common skin, both to give form to the limb and strength to its muscles, and to keep the individual muscles in their proper places, which otherwise might be luxated and displaced. And so the trunk of the body, the arm, the thigh, the leg, are bound each with a strong, smooth, and glistening sheath, formed out of the cellular substance, condensed and thickened by continual pressure. And this also is thicker and stronger according to the need that there may be for such a help; for it is weaker over the flat muscles of the back or of the abdomen, stronger on the arm, stronger still over the strong muscles of the thigh. It is hardly to be distinguished in the child; grows thicker and stronger as we advance in years and in strength, and in the arms of workmen it grows particularly thick and strong, increasing in the back, shoulder, or limbs, according to the particular kind of labour. These are the membranes which, by inclosing the muscles like sheaths, are called the VAGINA, or FASCIA of the arm, the leg, the thigh, &c.

4. TENDONS or ropes were needed, for the muscles could not be implanted thick and fleshy into each bone without a deformity of the limbs, and especially of the joints; which would have been not unshapely only, but which must have abridged them of their motions and uses. Where a muscle is not implanted directly into a bone, tendons are seldom required; and so there are no tendons in the heart, the tongue, the œsophagus, the stomach, intestines, or bladder. But where tendons pass over bones, or traverse the joints, their force is concentrated into narrower bounds; and long tendons are fixed to the ends of the muscles to pull the bones: these tendons were once believed to be but the collected fibres of muscles, gathered into a more condensed form; by which condensation their properties of feeling and motion were lost, while they became hard, white, and glistening; and it was believed that parts which were fleshy in the child became tendinous in the adult. But we know by the microscope that the tendon is not truly continued from the flesh; that the fibres of the tendon and of the flesh are not in the same line, the fibres of all penniform muscles running into their tendon, in a direction more or less oblique; and good anatomists have been able to separate the tendon from the flesh, without any violence, and with the bluntest knives. Muscles are irritable and have

nerves ; tendons are quite dead, have no visible nerves, have neither feeling nor motion, nor any endowment by which we should believe them to be allied to the living parts of the system ; and many tendons, as the expansion of the palmaris, may be unravelled into mere cellular substance.

5. The PERIOSTEUM is merely a condensation of the common cellular substance, formed in successive layers : and the tendons are of the substance of the periosteum ; they mix with the periosteum, and are implanted into it. In dissecting a child, we tear up the periosteum along with tendons, and without hurting the bones ; but in process of time, the periosteum, and consequently the tendons, are inseparably fixed to the bones. The periosteum, tendons, fasciæ, and bursæ mucosæ, are all of one substance, and of one common nature ; they are various modifications of that dead matter which, having but little vascularity, and no feeling, and hardly any disposition to disease, is the fittest for its office, and bears the roughest usage in our experiments, and the most violent shocks in the motions of the body, without any signs of feeling, and without falling into disease.

6. These tendons must be bound firmly down ; for if they were to rise from the bones during the actions of the muscles to which they belong, the effect of contraction would be lost, and they would disorder the joint, starting out in a straight line from bone to bone like a bow-string over the arch of a bow. The same inanimate substance still performs this office also ; for the tendons of one muscle often split to form a sheath or ring for the next ; or their tendons after taking hold of the bone, spread their expansion out over all the bone, so as to form an entire sheath for the finger and toe ; or there is a wide groove in the bone which receives the tendons, and it is lined with a cartilage and with a lubricated membrane ; the membrane comes off from the lips of the groove, or from corners or edges of the bone, passes over the tendons so as to form a bridge, or often it forms a longer sheath, as in the fingers, or where the peronæi muscles pass behind the ankle ; and thus the VAGINÆ or SHEATHS of the TENDONS are connected with the tendons, periosteum, and other modification of the common cellular membrane.

7. The periosteum, which has run along one bone, leaves it at the head, and forming a bag for the joint, goes onwards to the next bone. Thus the periosteum of all the bones is one continued membrane, passing from point to point : each bone is tied to the next by its own periosteum ; and this membrane betwixt the end of one bone and the beginning of the next, is so thickened into a strong and hard bag, as to form the capsule

of the joint; and the periosteum is assisted in performing this office by the tendons, fasciæ, bursæ, and all that confusion of cellular substance which surrounds the joint. The CAPSULE of the JOINT is then a firm and thick bag, which, like a ligament, binds the bones together, keeps their heads and processes in their right places, contains that glairy liquor with which the heads of moving bones are bedewed, and prevents the adjacent parts from falling inwards, or being catched betwixt the bones in the bendings of the joints. The capsule of every joint proceeds from the periosteum, and is strengthened by the tendons; it is formed like these parts, out of the cellular membrane; and when a bone is broken, or its periosteum destroyed by any accident or disease, when a tendon snaps across, when a joint is luxated, and the capsule torn, the injury is soon repaired by a thickening of the cellular substance round the breach; and wherever a bone, being luxated, is left unreduced, a new socket, new periosteum, new ligaments, and new bursæ, are formed out of the common cellular substance; and though the tendons may have been torn away from the head of the bone, they are fixed again, taking a new hold upon the bone.

8. There are other LIGAMENTS of a joint which prevent its luxation, guarding it at its sides, or round all its circle, according to its degree of motion; and those ligaments are of the same nature with the first or bursal ligaments; arise, like them, from the periosteum chiefly; or indeed are truly but a thickening of the bursal ligament at certain points.

The universal connection of these parts is now sufficiently explained, since we have followed the several forms of cellular substance: 1st, Clothing the bones with a thick membrane, which, though insensible, and almost inanimate in its own nature, conveys blood-vessels, the means of life, to the bones, and is named periosteum: 2dly, The same periosteum, thickened and strengthened by the adhesion of surrounding parts, so as to form the capsules for the joints: 3dly, The tendon, also continued from the periosteum, and not growing from the muscle, but merely joined to it: 4thly, We see that smaller tendon, expanded into a thinner tendinous sheet, as in the brawn of the leg where the ham-strings (whose expansion strengthens the knee-joint) go down over the muscles of the leg: 5thly, We see the perpendicular partitions of this fascia going down among the muscles, and dividing them from each other; and the cellular substance, which lies under the fascia, and immediately surrounds the muscle, cannot be distinguished from the inner surface of the fascia itself: 6thly, And as for the bursæ, we see that they are formed wherever a tendon rubs

over a bone. The upper surface of the bursa is formed by the tendon which rubs over the bone; the lower surface of the same bursa is formed by the periosteum of the bone which it defends; the sides are formed by the common cellular substance. Its cavity appears to be merely an enlarged cell; and the bursæ mucosæ and capsular ligaments are plainly of one and the same nature; their liquors are the same; they often open into one another naturally, or if not naturally, at least it is no disease, since no bad effects ensue.

I must now explain more fully the constitution and nature of all the less feeling parts: for what I have said might be thought to imply absolute insensibility and total exemption from disease or pain; whereas the sensibility of tendons, ligaments, bursæ, and joints, stands on the same footing with the feeling of bones: they are insensible in health; not easily injured; entering slowly into disease; but their diseases are equally dreadful from their duration and from their pain: for by inflammation their organization is deranged, their healthy consistence destroyed, and their sensibility excited in a dreadful degree.

The tendons of animals have been cut or pierced with embowelling needles; they have been pinched with nippers, and torn and cauterised; they have been burnt with a lighted stick, while the creatures neither struggled nor shrunk from the irritation, nor ever gave the smallest sign of pain. Oil of vitriol has been poured upon each of the parts belonging to a joint, and a piece of caustic has been dropped into its cavity, but still no pain ensued; nay, some have been so bold, may I not say so vicious, as to repeat these experiments upon the human body, pinching, pricking, and burning the tendons of the leg, and piercing them with knives, in a poor man, whose condition did not exempt him from this hard treatment; who was ignorant of this injustice that was done to him, while his cure was protracted, and he was made a spectacle for a whole city. Without such cruel and inhuman practices, we do not want opportunities of knowing, that, in the human body also, the tendons and bursæ have no acute feeling. When we cut open a fascia or tendinous membrane, there is little pain: when (as in amputation) we cut the ragged tendons even and neat, there is no pain: when we snip with our scissars the ragged tendons of a bruised finger to cut it off, the patient does not feel: when we see tendons of suppurating fingers lying flat in their sheaths, we draw them out with our forceps, or touch them with probes, without exciting pain: in the old practice of sewing tendons there was some danger, but no immediate pain: when we cut

down into the cavity of a joint, still the pain is but slight. In a luxation there is comparatively little pain. There is no pain when the ligament of the patella is broken away from the tibia, nor when the great Achillis tendon is torn. There is but little pain in the moments of those accidents which appear slight in the time, but which turn out to be the most dreadful sprains. Yet after rupture of the patella, the knee inflames and swells: after rupture of the Achillis tendon, there is swelling and inflammation, with such adhesion of the parts as makes the patient lame: after the slightest sprain such inflammation sometimes comes on as destroys the joint. There is but little pain when we first make an opening into any joint; yet it often brings on such pain and fever that the patient dies. In short, every thing conspires to prove, that though in wounds of the less feeling parts, there is indeed future danger, there is no immediate pain. Still there are many accidents which prove to us, that even in health the joints are not entirely exempted from pain: a smart stroke on the knuckles, or a blow on the elbow, or a fall upon the knee, are not perhaps the purest instances of feeling in joints; for such blow may have hurt some external nerve: but when a small moveable cartilage forms within the joint of the knee, though it be small and very smooth, and lodged fairly within the cavity of the joint, it often gets betwixt the bones, causing instant lameness; the moment it causes this lameness it brings dreadful pains: the pain, the lameness, and all the feeling of inconveniency, subside the instant that this cartilage is moved away from betwixt the bones; and the joint continues easy till this moving cartilage chances again to fall in betwixt the heads of the bones. Even the pain from a blow upon the knee, for example, is plainly within the joint, and is caused by the force with which the patella is struck down against the ends of the bones. What indeed is a sprain, but a general violence and twisting of all the parts which compose the joint? These parts are of one common nature, and maybe arranged and enumerated thus: a joint is composed of the heads of the bones, swelling out into a broader articulating surface, and of a thin plate of cartilage, which covers and defends the head of each bone; sometimes of small and moveable cartilages which roll upon the bones, and follow all the motions of the joint, and, like friction-wheels in machines of human invention, abate the bad effects of motion. There are mucous glands, or rather mucous bags, which convey a lubricating fluid: and there is a bursal ligament, which forms the purse of the joint, binds the bones together, contains the synovia, and prevents the surrounding parts from being catched in the joint: there are lesser liga-

ments on the outside of this, going along the sides of the joint, and passing from point to point: there are great tendons moving over the joint and bursæ, or mucous bags, which accompany these tendons, and prevent the violence which their continual rubbing might do to the bones. All these parts are of one constitution and nature; we cannot say that they are insensible, for their feeling is only deferred; it is slow, but not the less severe. The eye feels the instant that a mote falls upon it; but the skin does not feel a blister till it has been some hours applied; the ligaments and joints feel still less in the instant that any injury is done: but as the inflammation of the blister excites the feeling, and destroys the fabric of the skin, producing pain and derangement of its parts, the inflammation of joints, and of all the parts belonging to them, breaks up the organization of the part, evolves the feeling, and then in them also comes disease and violent pain. They are slow in entering into action; but, once excited, they continue to act with a perseverance quite unknown in any other part of the system.—Their mode of action, whatever it may be at the time, is not easily changed: if at rest, they are not easily moved to action, and their excessive action once begun is not easily allayed.—The diseases are infinite to which these parts are subject. They are subject to dropsical effusions; they are subject to gelatinous concretions; they are subject to slight inflammation, to suppuration, to erosions of their cartilages, and to exfoliation of their bones: corresponding with the dropsies, suppurations, and mortifications of the softer and more feeling parts. Rheumatism is an inflammation round the joints, with a slighter effusion, which is soon absorbed: chronic rheumatism is a tedious and slow inflammation, with gelatinous effusions round the tendons, and permanent swelling and lameness of the joints. Gout in a joint is a high inflammation, with a secretion of earthy matter into its cavity. The inflammation of tendons is sprain: effusions of gelatinous matter round them is ganglion: suppurations in the tendinous sheaths is whitloe: the inflammation of bursæ is false white swelling, not easily distinguished from the true: the disease of the joint itself is either a dropsy, where the joint, though emptied by the lancet, is filled up again in a few hours, showing how continual, and how profuse, both the exhalation and absorption of joints naturally is; or it is white swelling, which, next to consumption, is the most dreadful of all scrophulous diseases, which begins by inflammation in the joint itself, is marked by stiffness, weakness, loss of motion, and pain; which goes on through all the stages of high inflammation, dreadful pain, destruction of cartilages, en-

largement of bones, fœtid suppurations, and spontaneous openings of the joints; which sometimes stops by an effusion of callus and concretion of the bones, forming a stiff joint, but which oftener ends in hectic fever, diarrhœa, morning sweats, and extreme weakness; so that the patient dies, exhausted with fever and pain.

BOOK III.

OF THE JOINTS.

CHAP. I.

JOINTS OF THE HEAD AND TRUNK.

JOINTS OF THE HEAD AND SPINE.

ALMOST every thing relating to the heads and processes of the bones, and every proposition concerning the motions which they have to perform, has been already explained, anticipating much of the anatomy of the joints: and the principles of motion mentioned in describing the bones shall form the chief propositions on which my descriptions of joints shall be arranged, seeking that method chiefly by which the joints may be easily and rapidly explained; for it is a subject on which volumes might be bestowed, and not in vain.

We may compare in the following order, the chief motions of the head and trunk. The head is so placed upon the oblique surfaces of the atlas, that it cannot turn in circles; but at that joint all the nodding motions are performed. The atlas rests so upon the dentatus, that there all the turning motions are performed. The neck and loins have their vertebræ so loosely framed, with such perpendicular processes and easy joints, that there all the bending motions are performed; while the back is fixed, or almost fixed, by its connection with the ribs, and by the obliquity and length of its spines; and though upon the whole, the spine turns many degrees, yet it is with a limited and elastic motion where the whole turning is great, but the movement of each individual bone is small.

To secure these motions, we find, 1. The occipital condyles received into hollows of the atlas, where the oblique position of the condyles secures the joint, the occipital condyles looking outwards, the articulating surfaces of the altas looking towards each other, the occiput set down betwixt them, so as to be secured towards either side, and the obliquity of the joints being such withal as to prevent the head from turning round. These joints of the occiput of the atlas are, like the greater joints of the body, secured with regular capsules or bag-like ligaments for each condyle, each rising from a rough surface on the vertebra, and being fixed into a roughness at the root of the condyle. 2. We find a flat membranous ligament, which extends from the ring of the atlas to the ring of the occipital hole, closing the interstice betwixt the occiput and the atlas : it is confounded at the sides with the capsules of the articulating processes ; is very strong before ; and at the middle short point of the atlas it seems a distinct ligament, which is strong only at this point, and very lax and membranous behind.* 3. We find the atlas tied to the dentatus by a more complete order of ligaments.— These are, 1st, (as betwixt the atlas and occiput,) regular capsules or bags, fixing the condyles of one vertebra to the condyles of the other. 2dly, A cross ligament,† which, crossing the ring of the first vertebra, makes a bridge, embraces the neck of the tooth-like process, and ties it down in its place. 3dly, A smooth and cartilaginous surface all round the root of the tooth-like process, where this tooth of the dentatus turns in the ring of the atlas, and is bound by the ligament ; and this rolling of the atlas upon the axis of the dentatus is so fair and proper a joint, that it also is all included in a capsular ligament. 4thly, The point of the tooth-like process having threaded the ring of the atlas, almost touches the occipital hole ; and there another ligament ties it by its point to the occipital hole.‡

All the other vertebræ have another kind of articulation ; to which the occiput, atlas, and dentatus, are the only exceptions ; for their motions are particular, and quite different from the

* This is part of what Winslow called LIGAMENTUM INFUNDIBULIFORME, a FUNNEL-LIKE LIGAMENT, joining the firſt vertebra to the occiput.

† Viz. LIGAMENTUM TRANSVERSALE, or TRANSVERSUM; and what are called the APPENDICES of the TRANSVERSE LIGAMENT, are merely its edges extending upwards and downwards, to be fixed into the dentatus, and into the occipital hole, so as to incloſe the tooth-like process of the dentatus in a capsule.

‡ There are two flat ligaments which come from about the neck or root of the tooth-like process, and which go obliquely upwards, to be fixed into the groove juſt behind the lip of the occipital hole ; but the ligament from the point of the tooth-like process is not what it has been ſuppoſed, a fair round ligament of some ſtrength ; there is nothing more than a few ſtraggling fibres of ligament going from the point to the occiput, though Euſtachius has drawn it round and ſtrong.

rest. The atlas and dentatus bend, turn, and roll, by connections resembling the common joints of the body; but the other vertebræ are united, each by its INTERVERTEBRAL SUBSTANCE, to the bones above and below; they are also united by their articulating processes to each other: each articulating process is held to another by a distinct capsule: each intervertebral substance is secured, bound down, and strengthened by strong ligaments; for the intervertebral substance, which of itself adheres very strongly to the periosteum, and to the rough socket-like surface upon the body of each vertebra, is further secured by a sort of cross ligaments, which go from the rim or edge of one vertebra to the edge of the next, over the intervertebral substance; and so, by adhering to the intervertebral substance, they strengthen it. These ligaments cross each other over the interstice betwixt each vertebra, and are very strong. They are very regular, beautiful, and shining, and are named INTERVERTEBRAL LIGAMENTS.

The spine is further secured by a general ligamentous or tendinous expansion, which goes over the fore parts of all the vertebræ from top to bottom of the spine. It begins at the fore part of the atlas; it almost passes the body of the dentatus, or is but very slightly attached to it. It is at first pointed, small, and round; it begins to expand upon the third vertebra of the neck, so as to cover almost all its body. It goes down along the bones, chiefly on their fore parts, and is but little observed on their sides. It is weaker in the neck, where there is much motion; stronger in the back, where there is none; weaker again in the loins, where the vertebræ move; but still on the bodies of all the vertebræ it is seen white, shining, and tendinous. We can distinguish all along the spine interruptions and fasciculi, or firmer bundles, going from piece to piece of the spine; which fasciculi are indeed very seldom continued without interruption farther than the length of two or three vertebræ; yet the whole is so much continued, that it is considered as one uninterrupted sheath, and is called the EXTERNAL or ANTERIOR VAGINA, or LIGAMENT of the SPINE*.

But still the canal of the spine were left open and undefended, rough and dangerous to the spinal marrow, if internal ligaments were not added to these. The rings of the vertebræ are held at a considerable distance from each other, by the thickness of the intervertebral substance, and by the corres-

* The LIGAMENTUM COMMUNE ANTERIUS, FASCIA LONGITUDINALIS ANTERIOR, FASCIA LIGAMENTOSA, &c. It is from this ligament in the loins that the crura diaphragmatis arise, with tendons flat and gliftening like the ligament itfelf, and hardly to be distinguifhed from it.

ponding length of the oblique processes: but this space is filled up by a strong flat ligament, which goes from the edge of one ring to the edge of another; and so extending from the articulating processes, backwards to the spinous processes, they fill up all the interstice, complete the canal of the spinal marrow, and bind the bones together with great strength*: these are assisted in their office of holding the vertebræ together, by a continuation of the same ligament, or of a ligamentous membrane connected with it, which runs all the way onwards to the ends of the spinous processes, where they are strengthened by accidental fasciculi†; and in the middle vertebræ of the back, but not of those of the loins or neck, similar ligaments are found also betwixt the transverse processes‡.

Next, there is another internal ligament, which is not interrupted from bone to bone, but runs along all the length of the spine, within the medullary canal, and it corresponds so with the external vagina, or anterior ligament of the spine, that it is called the POSTERIOR or INTERNAL ligament§. It begins at the occiput, lies flat upon the back part of the bodies of the vertebræ; at the interstice of every vertebra it spreads out broad upon the intervertebral substance, doing the same office within, that the intervertebral ligaments do without. It is broader above; it grows gradually narrower towards the loins. Although it is called a vagina or sheath, it does by no means surround nor inclose the spinal marrow, but is entirely confined to the covering of the bodies of the vertebræ, never going beyond the setting off the articulating surfaces, or the place where the nerves go out. It adheres firmly to the bones, and does not belong at all to the spinal marrow. It should rather be called a ligament for the bones than a sheath for the medulla. The anterior ligament prevents straining of the spine backwards: this one prevents the bending of the spine too much forwards; and they inclose betwixt them the bodies of the vertebræ and their intervertebral substances.

There is yet a third internal ligament, which belongs entirely to the neck; it is called APPARATUS LIGAMENTOSIS COLLI;

* They are named the LIGAMENTA SUBFLAVA CRURUM PROCESSUUM SPINOSORUM.

† These are named the MEMBRANÆ INTERSPINALES, and LIGAMENTA APICES SPINARUM COMITANTES. The ligaments which tie the points of the spines, running from point to point, make a long ligament, which ſtretches down all the spine.

‡ Called LIGAMENTA PROCESSUUM TRANSVERSORUM, and found only from the fifth to the tenth vertebra of the back.

§ FASCIA LIGAMENTOSA POSTICA, FASCIA LONGITUDINALIS POSTICA, LIGAMENTUM COMMUNE POSTERIUS.

it begins from the edge of the occipital bone, descends in the canal of the vertebræ, is thin and flat, and adheres firmly to the body of each vertebra, covering the tooth-like process. The irregular fasciculi, or bundles of this ligament, stretch from bone to bone; and the whole of the apparatus ligamentosus extends from the edge of the occipital hole to the fourth vertebra of the neck, where it ends. Its chief use is also as a ligament, merely fixing the head to the neck. The dura mater is within these, immediately inclosing the spinal marrow. The ligaments which I have just named may be well enough allowed to be "at once ligaments for the bones, and a sheath for the medulla." But there is no such sheath as that called ligamentum infundibuliforme by Winslow; for either they are peculiar and distinct ligaments for the bones, such as I have described, or they belong exclusively to the medulla, as the dura mater, which is indeed strengthened at certain points into the thickness of a ligament; but the only close connection of the spinal marrow with the ligaments of the spine is just at the hole of the occipital bone, and for a little way down; through all the rest of the spine, the connection is by the loosest cellular substance.

OF THE LOWER JAW.

The lower jaw is, by its natural form, almost a strict hinge, and the lateral motion in grinding is but very slight. The joint is formed by a deep hollow or socket in the temporal bone; by a ridge, which stands just before the proper socket, at the root of the zygomatic process; and by a long small head or condyle, which is placed across the long branch or condyloid process of the jaw. These form the joint; and the condyle, the hollow of the temporal bone, and the root of the zygomatic process, are all covered with articulating cartilage. The joint is completed by a capsule of the common form, which arises from the neck of the condyle, and which is so fixed into the temporal bone as to include both the proper socket and the root of the zygomatic process. Thence it is manifest, that in the motions of the jaw, this transverse ridge is required as a part of its articulating surface; that the common and lesser motions are performed by the condyle moving in the deepest part of its socket; that the larger and wider openings of the mouth are performed by such depression of the jaw as makes its condyle mount upon the root of the zygomatic process; while the luxation of the jaw is a starting forwards of the condyle, till it is lodged quite before and under the

zygomatic process, and the condyle standing upon the highest ridge, is the dangerous position in which luxation is most easily produced.

To render these motions very easy and free, a moveable cartilage is interposed. We find such cartilages in the joints of the clavicle, wrist, knee, and jaw, because the motions are continual and rapid. The moveable cartilage is thin in its centre, and thicker towards its edges, by which it rather deepens than fills up the hollow of the joint. It corresponds in shape with the head or condyle of the jaw, and with the hollow of the temporal bone. It moves with every motion of the jaw, facilitates the common motions, and prevents luxation; but the joint is still more strongly secured by the strength of its pterygoid and temporal muscles, which are inserted close round the joint, than by any strength of its capsule. It is the muscles which prevent luxation; and it is their action also that makes luxation, when it has happened, so difficult to reduce.

RIBS.

The ribs have two joints, and a hinge-like motion, rising and falling alternately as we draw in or let out the breath. The two joints of the ribs are thus secured: First, the proper head of the ribs being hinged upon the intervertebral substance, and touching two vertebræ, it is tied to the bodies of each by a regular capsule: the bag is regular, is lubricated within, and is as perfect as any joint in the body; it is radiated without, so as to expand pretty broad upon the sides of the vertebræ, and has a sort of division as if into two fasciculi; the one belonging to the vertebra above, the other to the vertebra below: they gradually vanish, and mix with the periosteum upon the bodies of the vertebræ; these are named LIGAMENTUM CAPITELLI COSTARUM, as belonging to the little heads of the ribs.

The back of the rib touches the fore part of the transverse process, and is articulated there; consequently there is a small capsular ligament belonging to this joint also: but this joint is further secured by two small ligaments, which come from the transverse process of the vertebra, and take hold on the neck of the rib: one short ligament coming from the point of the transverse process, is behind the rib, and is thence named LIGAMENTUM TRANSVERSARIUM EXTERNUM: another, rather longer, comes from the inner face of the transverse process, goes a little round the neck of the rib, is implanted into the lower edge of the rib, and is named LIGAMENTUM TRANSVERSARIUM

INTERNUM : another small ligament exactly opposite to this, going into the neck of the rib upon its back part, is also very regular ; and other subsidiary ligaments from different points assist these or supply their place.

The ribs are fixed into the sternum by their cartilages ; each of which has a round head, a distinct socket, a regular capsule, and ligaments which expand upon the surface of the sternum, much in the same way that the ligamenta capitelli expand upon the bodies of the vertebræ : a tendinous membrane also binds the cartilages of the ribs one to another, crosses over the interstice, and so covers the intercostal muscles with a sort of fascia ; and the whole surface of the sternum and that of the cartilages is covered with this tendinous expansion, which belongs confusedly to the origins of the pectoral muscles, to the ligaments of the ribs and sternum, and to the periosteum of that bone.

CHAP. II.

JOINTS OF THE SHOULDER, ARM, AND HAND.

CLAVICLE.

THE joining of the clavicle with the sternum is the hinge upon which the whole arm moves, and is the only point by which the arm is connected with the trunk : the round button-like head of the clavicle rolls upon the articulating surface of the upper bone of the sternum : it is in such continual motion that some particular provision is required ; and accordingly it has, like the condyle of the jaw, a small moving cartilage, which rolls betwixt this head and the sternum. The cartilage is thin, and of a mucous nature ; it is moveable in some degree, yet it is fixed by one edge to the head of the clavicle. This joint is inclosed in a strong capsule ; consisting first of a bag, and then of an outer order of fibres, which go out in a radiated form, upon the surface of the sternum, like the ligaments of the ribs ; and they cross and cover the sternum, so that the ligaments of the opposite sides meet ; and this meeting forms a cord across the upper part of the sternum, which is named INTERCLAVICULAR LIGAMENT. Thus is the clavicle fixed to the sternum, and another broad ligament also ties it to the first rib.

The joining of the clavicle with the scapula is by the edge of the flat clavicle touching the edge of the acromion processes with a narrow but flat articulating surface. Both surfaces, viz. of the acromion and of the clavicle, are covered with a thin articulating cartilage: in some subjects a moveable cartilage is also found here. It is a regular joint, and is very seldom obliterated; yet its motion, though continual, is not very free; it is rather a shuffling and bending of the scapula upon this bone, favouring the play of the other joints. It is secured first by a capsular ligament, which is in itself delicate and thin, but which is strengthened by many ligamentous bands, which pass (over the capsule) betwixt the clavicle and the acromion process: the clavicle, as it passes over the point of the coracoid process, is tied down to it by a ligament of considerable strength, which comes from the point of the coracoid process, is implanted into the lower or inner edge of the clavicle, and is named LIGAMENTUM COMMUNE TRAPEZOIDES; trapezoid, on account of its square form, and commune, because it goes from the scapula to the clavicle; while other ligaments, going from one process of the scapula to another, are named proper or peculiar ligaments of the scapula. There is a small slip of ligament which joins this, coming from the tendon of the subclavian muscle.

SHOULDER-JOINT.

THE SHOULDER is one of the most beautiful joints, loose and moveable, very free in its motions, but very liable to be displaced. To form this joint, the humerus has a large round and flattened head; the cavity of the scapula,* which receives this head, is oval or triangular, small and very shallow: it is eked out with a thick cartilaginous border, which increases the hollow of the socket; but still it is so shallow that the humerus cannot be so much said to be lodged in the glenoid cavity, as to be laid upon it. Its capsule or bag is very loose and wide, coming from the edges of the glenoid cavity, and implanted round the neck of the bone. The joint is richly bedewed with mucus; or rather with a mixed secretion, which is partly secreted by a fimbriated organ, consisting of lacunæ or bags, the common organ for this secretion through all the joints, and by a thinner exudation from those extreme arteries, which terminate, with open mouths, upon the internal surface of the bag.

* It is called glenoid cavity from the Greek name of a joint, and the name is not absolutely appropriated to the scapula.

By the shallowness of its socket, and the largeness of its head; by the looseness of its capsule; by all the forms and circumstances of its structure;—the shoulder is exceedingly loose, and very liable to be displaced: it has this loose structure and superficial socket, that its motions may be free; but seldom is there any great advantage gained in the human body without a counterbalance of weakness and danger; and every where in the limbs we observe that a joint is weak and liable to luxation in proportion as its motions are free and large. Yet the shoulder-joint is not without some kind of defence; its socket is shallow, but it is guarded by the largest projecting process in all the body; by the acromion projecting and strengthening it above; and by the coracoid process within; its ligament is lax, easily torn, and useful rather for confining the synovia, and keeping the head of the shoulder-bone opposite to its proper cavity, than in securing the joint by any strength it has; therefore a ligament extends from the coracoid to the acromion process,* which completes the defences of the joint above, and at its inner side; and there comes also from the point of the acromion process an additional ligament which adheres to the capsule: but the circumstance from which the chief strength of the shoulder-joint is derived, is the insertion of the four muscles which come from the shoulder-blade close round the head of the bone; so that they adhere to the capsular ligament, pull it up to prevent its being checked in the motions of the joint; strengthen it by their thickness, for they are spread upon it: and the contraction of the muscles holds the humerus in its place; their total relaxation (as in certain cases of weakness) suffers the humerus to drop away from the scapula, without any fall or accident, forming what we are accustomed to call a luxation of the humerus from an internal cause; and the shoulder cannot be luxated by a fall without such violence as tears up these muscles by the roots. We must add to this anatomy of the joint, that it is surrounded by numbers of bursæ or mucous bags:† one under the tendons of the subscapularis; one under the short head of the biceps muscles; one betwixt the coracoid process and the shoulder-bone; and one under the acromion process of the scapula, exceedingly large: and these are so fairly parts of the joint, that very commonly

* Ligamentum proprium triangulare scapulæ.

† Vide Monro's Tables of the Bursæ Mucosæ, where all these parts are represented; the knowledge of which is so very useful for the surgeon. I have opened this great bursa under the acromion process, and let out four pounds of the peculiar mucus and gelatinous lumps with which the diseased bursæ are commonly filled.

they open into it with communications, either perfectly natural or at least not hurtful, either originally existing or formed by continual friction. It should also be remembered, that the long tendinous head of the biceps muscle comes from the margin of the socket, directly over the ball of the os humeri, and through the capsule, by a particular hole.

ELBOW.

THE ELBOW-JOINT is formed by three bones ; the humerus, radius, and ulna : the ulna bends backwards and forwards upon the shoulder-bone ; the radius bends upon the shoulder-bone along with the ulna ; it always must accompany the ulna, but it also has a motion of its own, rolling in circles ; its round button-like head rolling continually with its edge upon a socket in the ulna, and with its flat face upon the tubercle of the humerus. The whole composes one joint, and is inclosed in one capsule : the bones accompany each other in their luxations, as well as in their natural motions : the ulna is never dislocated without the radius being also displaced ; a circumstance which is but too little noticed, and, so far as I remember, hardly considered or known. The general CAPSULE arises from the humerus, from both the tubercles, and all round the two hollows which receive the olecranon and coronoid processes of the ulna ; it is implanted again into the tip of the olecranon, and all round that sigmoid cavity which receives the lower end of the humerus, and all round the edge of the coronary process. It is also fixed round the neck of the radius ; it comprehends, in one bag, the humerus, radius, and ulna ; and unites them into one joint, performing two motions, viz. flexion and extension by the ulna, and rolling by the radius. The joint is lubricated by mucus and by fat, which is found chiefly about the olecranon ; and that the bones may be further secured, additional ligaments are spread out upon them, which are all without the common capsule of the joint lying upon it, and strengthening it at the necessary points.

1. There is the common capsule inclosing the whole. 2. It is the form of every hinge-joint (and this is one of the purest) to have its capsule strengthened at the sides ; and the sides of this, the elbow-joint, are strengthened by two fasciculi or ligamentous heads, which, coming from the tubercles of the humerus, spread a little upon the capsule, and adhere to it like part of its substance. One, from the outer condyle, spreads upon the neck of the radius, and is named the EXTERNAL LATERAL LIGAMENT : one from the inner condyle of the humerus, goes

upon the inside of the capsule, and strengthens it there : it is implanted near the root of the coronoid process of the ulna, and is named the INTERNAL LATERAL LIGAMENT. 3. The continual rolling motion of the radius requires a peculiar ligament ; and this peculiar ligament of the radius is named LIGAMENTUM CORONARIUM, because it encircles the neck of the radius ; ANNULARE or ORBICULARE, from its hoop or ring-like form. It is a very strong and narrow stripe or band, which arises from that part of the ulna where the radius rolls upon it, and surrounds the radius, making at least two-thirds of a circle ; and so having turned over the neck of the radius, is inserted into the opposite side of the ulna. This is commonly described as a distinct ligament surrounding the neck of the radius, and having the common capsule implanted into its upper edge ; but in truth it is, like the others, a thicker band of the common capsule, but with a distinction much more particular here, by the contrast of the great thickness of the coronary ligament, and the extreme thinness of the capsule at the fore part : for the capsule of every hinge-joint is strong only at its sides ; other bands from the outer condyle, and from the coronary process of the ulna, strengthen this ligament of the radius, and are known by the general name of ACCESSORY LIGAMENTS of the coronoid ligament, as the lateral ones are known by the name of ACCESSORY LIGAMENTS to the capsule.

So that there is, 1. A complete capsule which encloses all the bones ; 2. Lateral ligaments which make the main strength of the joint; 3. A coronary ligament which regulates and strengthens the rolling motions of the radius, and keeps it firm, turning like a spindle in its bush. The whole joint is surrounded with cellular substance ; the regularity of its ligaments is confounded by the adhesions of muscles and tendons : though it is, on the whole, weak behind and before, and very strong at its sides, yet tendinous and ligamentous fibres cross it in all directions ; so that the capsule, and its assisting ligaments, are irregular and rough without ; but gelatinous, smooth, and glossy within.

WRIST.

THE WRIST is one of the most moveable joints in the body, having the strength of a mere hinge-joint (because it is almost a strict hinge, by the connection of the long ball of the carpus with the long hollow of the radius ;) and having, at the same time, all the properties of the most moveable joint, by the free turning of the radius, without the weakness which is peculiar

to the circular and free moving joints. These distinctions divide the wrist-joint into its two parts.

1. The articulation formed by the scaphoid and lunated bones, which form an oval ball of articulation, and the great scaphoid cavity of the radius which receives this ball. The end of the ulna does not properly enter into the cavity of the wrist, but its end, or little round head, is covered with a moveable cartilage, and that cartilage represents the end of the ulna. Now this first joint, viz. of the scaphoid and lunated bones, the head of the radius, and the moveable cartilage which represents the head of the ulna, are surrounded by the general capsule or bag of the joint. The capsule arises from the ends of the radius and of the ulna ; from the styloid point of the one round to the same point of the other ; and is implanted near the lower rank of the carpal bones. Though it adheres first to the scaphoid and lunated bones, it passes them, going over all the bones of the carpus, especially in the palm, so as to add strength to their peculiar ligaments ; and in the palm, the tendons for the fingers run over it : so it forms on one side an additional ligament for the carpus ; on the other, it forms the floor of the tendinous sheath, a smooth and lubricated surface for the tendons to run upon. This general ligament is strengthened by particular ones coming from the styloid processes of the radius and of the ulna. But there are so many irregular points of bone about the wrist, that the little fasciculi, with which this capsule is covered and strengthened, are innumerable. Within this joint, and stretching from the groove betwixt the scaphoid and lunated bones, there is an internal ligament of a soft and pulpy nature ; it is named LIGAMENTUM MUCOSUM : but the very name shows that it is less valuable as a ligament (since the joint is already well enough secured,) than as a conductor for the lacunæ or ducts which separate the mucus.

2. The articulation by which the hand performs all its turning motions is that of the radius with the ulna : this is set apart altogether from the general articulation of the joint. The lateral cavity of the radius receives the little round head of the ulna ; they are enclosed in their own peculiar capsule ; which is so loose about the bones, that although it is a regular capsule of the common form, it has the name of MEMBRANA CAPSULARIS SACCIFORMIS. Thus there is one joint within another; a moveable cartilage betwixt them, and the capsule of one, the more moveable joint, peculiarly wide, and not so strong ; all which should be considered in thinking about luxations of the wrist.

The carpal bones are connected with each other so very closely, that the name of joint can hardly be used. They are

rather fixed than jointed together. Each bone has four smooth articulating surfaces, by which it is united to the adjoining bones. The first two bones form the great ball of the wrist; the second row again is united with the first by a sort of ball and socket; for the os magnum, which is the central bone of the second row, has a large round head, which is received into the lunated hollow of the os lunare, which is the central bone of the first row. The first row is thus united to the second by a distinct and general capsule; in addition to which each single bone is tied to the next adjoining, by a regular capsular ligament within, and by flat cross ligaments without, or rather by many bundles of ligaments, which cross each other in a very complicated manner; and the little flat and shining fasciculi give the whole a radiated or star-like form*.

The metacarpal bones are also joined to the carpal in one row, by a line of joints which are as one joint; besides their common capsule, the metacarpal of each finger has its peculiar ligaments proceeding in a radiated or star-like form from the carpal bones, and going out broad upon the metacarpal bones; and so numerous, that each metacarpal bone is securely tied by ligaments to one or two of the bones of the carpus †; and at their heads, where the fingers are implanted upon them, forming the knuckles, they are again tied by flat ligaments, which go from head to head of the metacarpal bones‡, binding them together, permitting a slight bending towards each other, so as to make a hollow in the hand, but no such wide motion as might assist the fingers; they are but as a foundation upon which the fingers stand and move.

FINGERS.

The joints of the fingers are formed by round heads in the upper end of one row of bones, and by hollow sockets on the lower ends of the next row. Each joint is qualified by the round form of its head to be a circular and free moving joint; but it is restricted by the forms of its ligaments to the nature of a hinge-joint; for each finger-joint is included first in a fair round capsule or bag, of the ordinary form; but that capsule

* These are ligaments which are really so unimportant to the anatomist or to the surgeon, but which are so laboriously described under the titles of LIGAMENTA BREVIA, OBLIQUA TRANSVERSARIA, and PROPRIA OSSIUM CARPI; for they do in fact cross and traverse the carpus in every possible direction.

† And these also are named, according to their several directions, LIGAMENTA ARTICULARIA, LATERALIA, RECTA, PERPENDICULARIA, &c.

‡ These are named the LIGAMENTA INTEROSSEA.

is strengthened by very distinct lateral ligaments upon its sides, which lateral ligaments form the chief strength of the joints; above these lateral ligaments the joint is strengthened by a broad fascia or sheath, which comes from the tendons of the interossei muscles, covers the backs of all the fingers, and which is especially strong over the joints. One part of the apparatus of the wrist-joint is the smooth and lubricated SHEATH, in which the tendons of the fingers run. It is formed in part by the outer side of the capsule of the wrist, and in part by that bridge of ligament which proceeds from the four corner points of the carpal bones. This sheath is lined with a delicate and softer modification of the common tendinous membrane; is fully bedewed with mucus; and is fairly to be ranked with the bursæ mucosæ, as it is indeed, like them, a shut sack. But it is farther crossed in such a manner by partitions belonging to each flexor tendon, that each of them may be said to have its appropriated bursa mucosa. And these bursæ, to prevent the bad consequences of friction, are put both betwixt the cross ligament and the tendons, and also betwixt the tendons of the uppermost muscle and of the deeper one, and again betwixt the tendons of the fingers and of the thumb.

In the same way the sheaths of the tendons, as they run along the fingers, may be considered as part of the apparatus of their joints; for the first set of bursæ, viz. those which lie in the palm of the hand, stop before they reach the first joints of the fingers, and then other longitudinal bursæ begin from the first joint of the fingers, and go all along them to the last joint; forming a sheath for the tendons to run in, which does at once the office of a strong ligament, binding them down in their places, and which is so lubricated on its internal surface as to save the necessity of other bursæ. These sheaths are thicker in certain points, so as to form cross rings of strong ligaments; but the common sheath and these thicker rings still form one continual canal: these are named the SHEATHS and ANNULAR LIGAMENTS, or CROSS LIGAMENTS*, of the fingers, and are of the same nature with the bursæ. Besides these, there are no distinct bursæ on the fingers, but there are several about the wrist, and one especially of a considerable size at the root of the thumb†.

* LIGAMENTA VAGINALIA, LIGAMENTA CRUCIATA PHALANGUM, &c.
† Vide Monro's Bursæ Mucosæ.

CHAP. III.

JOINTS OF THE THIGH, LEG, AND ANKLE.

OF THE HIP-JOINT.

THE acetabulum, which is rough in the naked bone, is naturally lined with a thick and very smooth cartilage. The head of the thigh-bone is covered with a similar cartilage, also very thick and smooth; and these cartilages almost fill up that deep dimple which is seen in the centre of the head of the thigh-bone, and smooth that hole which is formed in the centre of the socket, by the meeting of the several pieces of which it is composed. The socket is not only deep in its bones, but is further deepened by the cartilage which tips the edge of the socket, and which stands up to a considerable height. The socket is imperfect at that side which looks towards the thyroid hole; the bony edge is entirely wanting there, and the space is filled up by a strong cartilaginous ligament which goes across this gap, from the one point to the other, and from its going across is named the LIGAMENTUM LABRI CARTILAGINÆI TRANSVERSALE*. The capsular ligament of the hip-joint is the thickest and strongest of all the body. It is, like other capsules, a reflection and thickening of the periosteum; the periosteum coming along the outside of the bone, leaves it at the edge of the socket. The periosteum, or rather perichondrium from the inside of the socket, comes up to the edge, and meets the outer layer. They unite together, so as to form the general capsule, inclosing the ring-like cartilage, which tips the edge of the socket between them. This ligament incloses all the bones from the edges of the socket to the roots of the trochanters, embracing not only the head but the neck of the thigh-bone. The outer plate, continuous with the periosteum, is thick and strong, and is assisted by much cellular substance condensed round it, and it is further thickened by slips which come from the iliacus, glutæus, and other muscles which pass over the joint, while the external plate of the ligament lines the whole with a soft and well lubricated coat.

* This ligament is double; that is, there is one on the inside of the edge, and one on the outside; thence it is often reckoned as two ligaments, viz. LIGAMENTUM TRANSVERSALE INTERNUM et EXTERNUM.

In addition to this general capsule, there are two internal ligaments, 1st, The round ligament, as it is called, which comes from the centre of the socket to be fixed into the centre of the ball of the thigh-bone. It is not round, but flat or triangular. It has a broad triangular basis, rooted in the socket exactly at that place where the several bones of the socket meet, forming a triangular ridge, which gives this triangular form to the central ligament. It has three angles, and three flat sides. It is broad where it arises from the bottom of the socket, is about an inch and a half in length, grows narrower as it goes outwards towards the head of the bone, and is almost round where it is implanted into the dimple in the head of the thigh-bone; at which point it is so fixed as to leave a very remarkable roughness in the naked bone. But round the roots of this ligament, and in the bottom of the socket, there is left a pretty deep hollow, which is said to be filled up with the synovial gland. It is wonderful how easily authors talk of the synovial gland, as if they had seen it; they describe very formally its affections and diseases, as when hurt by a blow upon the trochanter; yet there is no distinct gland to be found. There is a fringed and ragged mass lodged in the bottom of the socket, hanging out into the hollow, and continually rubbed by the ball of the thigh-bone in its motions: the fringes and points certainly are ducts from which we can squeeze out mucus; but it is by no means proved that they belong to a synovial gland; and it looks rather as if the ducts were themselves the secreting organ, like the lacunæ or mucous bags in the tongue, or in the urethra, vagina, œsophagus, and other hollow tubes. Such a structure is fitter for suffering the strong pressure and continual action of the thigh-bone than any determined gland. We see then nothing but mucous ducts of a fringed form, hanging down from this hollow into the cavity of the joint; a quantity of fat accompanying these fringes; and a pappy mucous membrane, which keeps these fringes and fatty membranes orderly and in their places, and which ties them so to the angles of the triangular ligament, that they must move with the motions of the joint. This mucous membrane, which keeps these fatty fringes orderly, has two or three small bridles in different directions; whence they are named the LIGAMENTA MUCOSA, or ligamentula massæ adiposæ glandulosa; and this may be considered as the continued inflection of the softer internal lamella of the capsule, which not only lines the socket, but is reflected over the central ligament, and over the globe of the thigh-bone, covering them also with a delicate mucous coat. Other fringes of the same kind are found at the lower part of the joint, lying round the neck of

the thigh-bone, near the angle where the capsular ligament is implanted into the root of the great trochanter: the liquor from these mucous fimbriæ, with the general serous exudations, are mixed and blended for lubricating the joint.

This capsule, which is naturally the thickest and strongest in the body, almost a quarter of an inch in thickness, is farther strengthened by many additions: for a slip of very strong tendinous or cellular substance condensed comes down from the lower spinous process of the os ilium, and spreads out over the capsule, and strengthens it very much on its fore part; the smallest of the glutæi muscles adheres to the capsule and strengthens it behind; the psoas magnus and iliacus internus pass by the inner side of the capsule; and though they do not absolutely adhere to it, they deposit much cellular substance, which is condensed so as to strengthen the capsule, forming at the same time a large bursa mucosa betwixt their tendinous fibres and the joint. That tendon of the rectus muscle which comes from the margin of the socket, lies upon the outer side of the capsule, adheres to it, and strengthens it. The security of the hip-joint seems to depend more upon the strength of its capsular ligament than that of almost any other joint.

THE KNEE-JOINT.

The knee-joint is one of the most superficial joints and one of the weakest, so far as relates to the bones; for the flat condyles of the thigh-bone are merely laid upon the flat head of the tibia. There is here no fair cavity receiving a large head, as in the joint of the hip; no slighter ball and socket, as in the fingers; no strong overhanging bones, as in the shoulder; no hook-like process, as in the ulna. This is not a hinge-joint, like the ankle, secured between two points of bone. We do not find the means of strength in its bones, but in the number, size, and disposition of the great ligaments with which its bones are joined; by virtue of these ligaments it is the strongest joint of the human body, the most oppressed by great loads, the most exercised in continual motions, yet less frequently displaced than any other. But this complication of ligaments, which gives it mechanical strength, is the very cause of its constitutional weakness: makes it very delicate; and very liable to disease.

The bones which compose this joint are the tibia, thigh-bone, and patella; and they are united by many ligaments, both within and without the joint.

1st, The CAPSULE of the KNEE is naturally very thin and

delicate, transparent as a cobweb. This thin capsule comes from the fore part of the thigh-bone, all round the articulating surfaces, whence it goes downwards by the sides of the condyles; from this origin it is inserted into all the edge of the rotula, and in such a way as to keep the rotula properly without the cavity of the joint; the capsular ligament going over its inner surface, and lining it with a smooth and delicate coat. It is fixed below into all the circle of the head of the tibia, and thus completes its circle, embracing all the bones. This capsule, naturally so thin and delicate, is made up from all the surrounding parts to a considerable thickness; first, it is covered behind by the heads of the gastrocnemii; at the sides by the biceps and other muscles of the hamstrings; on its fore part, it is strengthened by the general fascia of the thigh, which goes down over the knee, and being there reinforced both by its adhesion to the bones and by the broad expansion of the vastus internus, sartorius, biceps, and other muscles which go out over the patella, it adheres to the capsule, and makes the whole very strong; besides which, there is a ligament which, lying in the ham, upon the back part of the capsule, is named, in compliment to Winslow, LIGAMENTUM POSTICUM WINSLOWII. It is a ligament somewhat resembling the lateral ligaments of the elbow. It arises from the outer condyle, goes obliquely across the back part of the joint, adheres to it, and strengthens it; but often it is not found at all, or in such straggling fibres as cannot be accounted as a ligament. It is manifest that the knee requires some such additional ligaments behind to serve as a check, and to prevent its yielding too far.

2. The knee, as being a hinge-joint, has its stronger ligaments at the sides; and although we speak of lateral ligaments in the other joints, this is the only one where the lateral ligaments are very distinct from the common capsule of the joint; on the inner side of the joint there comes down from the internal condyle of the thigh-bone a broad flat ligament, which is fixed into the inner head of the tibia, and is named the internal lateral ligament; on the outside of the knee there descends from the tip of the outer condyle a much stronger ligament, not quite so flat, rather round; it extends from the condyle of the thigh-bone to the bump of the fibula, which it embraces. It is a little conical from above downwards; it is from two or three inches in length, and is named LIGAMENTUM LATERALE EXTERNUM LONGUS, to distinguish it from the next: for behind this first external ligament there arises, a little lower from the same condyle, along with the outer head of the gastrocnæmius muscle, a ligament which is called the LIGAMENTUM LATERALE EXTERNUM BREVIUS; and it is not shorter only, but so

scattered as not to be easily distinguished, not having the true form of a lateral ligament coming down from the condyle, but of a mere strengthening of the capsule, coming upwards from the knob of the fibula.

3. The joint is still further secured by internal ligaments, which are within the cavity of the joint; they are named the CRUCIAL LIGAMENTS of the knee. They arise betwixt the hollow of the condyles of the thigh-bone, and are implanted into the back part of the middle rising of the tibia: they lie in the back part of the joint, flat upon the back of the capsule; and the one crossing a little before the other (but yet in contact with each other at the place of crossing,) they are distinguished by the names of ANTERIOR and POSTERIOR CRUCIAL LIGAMENTS.

The POSTERIOR CRUCIAL ligament is more perpendicular; it arises from the hollow betwixt the condyles of the thigh-bone, and is implanted into a roughness on the back of the tibia, betwixt its two cup-like hollows, and behind the tubercle which divides these hollows from each other. While the posterior arises rather from the internal condyle, the ANTERIOR LIGAMENT arises properly from the external condyle, passes obliquely over the tuber in the articulating surface of the tibia, and terminates in the cup-like hollow. The effect of these two ligaments is more particular than is commonly observed; for the one goes obliquely out over the articulating surface of the tibia, while the other goes directly down behind the joint; and of course when the knee is bended, the posterior ligament is extended; when the leg is stretched out, the anterior ligament is extended: they both are checks upon the motions of the joint: the anterior ligament prevents the leg going too far forwards; the posterior ligament prevents its being too much bent back upon the thigh.

4. The most admirable part of the mechanism of this joint is the two SEMILUNAR CARTILAGES. They are so named from their semilunar form; they lie upon the top of the tibia, so as to fill up, each of them, one of the hollows on the top of that bone. They are thicker towards their convex edges, thinner towards their concave edges; they end by two very acute and long horns, named the CORNUA of the lunated cartilages. In short, they resemble the shape of the label which we put round a wine decanter; and the two horns are tied to the tubercle or ridge that stands in the middle of the articular surface of the tibia; and consequently they are turned towards each other so as to touch in their points. There are here, as in the other joints, masses of fat inclosing the fimbriated ends of the mucous ducts. These fimbriæ and fatty bundles are formed chiefly round the circumference of the patella, commonly surround-

ing it with a complete fringe; they are also found at the back of the cavity, about the crucial ligaments, and in all the interstices of the joints; the fatty bundles filling up the interstices, protecting the mucous ducts from more violence than what is just necessary to empty them, and perhaps mixing their exudation with the mucus of the ducts.

These masses of fat lie covered by the delicate internal surface of the capsule, and the mucous fimbriæ project from it.

The inner surface of the capsule is so much larger than the joint which it lines, that it makes many folds or lurks; and several of these are distinguished by particular names. Thus at each side of the patella there are two such folds, the one larger than the other; whence they are named LIGAMENTUM ALARE MAJUS, and LIGAMENTUM ALARE MINUS. These two folds are like two legs, which join and form one middle fold, which runs across in the very centre of the joint, viz. from the lower end of the patella to the point of the thigh-bone, in the middle betwixt the condyles. It keeps the looser fatty bundles and fimbriated ducts in their place (viz. the hollow betwixt the condyles, where they are least exposed to harm,) thence it has been long named the LIGAMENTUM MUCOSUM.—The internal membrane of the joint covers also the semilunar ligaments as a perichondrium; it comes off from the ridge of the tibia, touches the horns of the semilunar cartilages, moves over the cartilage so as to give them their coat; and at the point where it first touches the horns, it forms four little ligaments, two for the horns of each cartilage. These tags, by which the four points of the lunated cartilages are tied, are named the LIGAMENTA CARTILAGINUM LUNATARUM, or more simply named the four adhesions of the lunated cartilages. There is a little slip of ligament which goes round upon the fore part of the knob of the tibia, and ties the fore parts of these two cartilages to each other. It is named LIGAMENTUM TRANSVERSALE COMMUNE, because it goes across from the fore edge of the one cartilage to the fore edge of the other, and because it belongs equally to each; but for their further security, these cartilages also adhere to their outer circle or thick edge, to the internal surface of the general capsule of the joint, and that again adheres to the lateral ligaments which are without it; so that there is every security for these cartilages being firm enough in their places to bear the motions of the joint, and yet loose enough to follow them easily.

This joint has the largest bursæ mucosæ of all, and these perhaps the most frequently diseased. There is one bursa above the patella, betwixt the common tendon of the extensor muscles and the fore part of the thigh-bone, which is no less

than three inches in length. There is a smaller bursa about an inch below the patella, and under the ligament of the patella, protecting it from friction, upon the head of the tibia. These bursæ, I am persuaded, are often the seat of disease, when it is judged to be in the joint itself. But the truth is very easily known ; for if a swelling appear under the patella, projecting at the sides, and raising the patella from the other bones, we are sure that it must be in the main cavity of the joint: but if swellings appear above and below the patella, then there is reason to believe that these belong to the great bursæ, which are placed above and below the patella : a complaint which is far less formidable than a swelling of the joint itself; I would almost say easily cured; for openings into these bursæ, though they should be avoided, are less dangerous than openings into the joint. It is from mistaking such tumours for collection in the capsule itself, that authors speak of openings into the joint as a familiar or easy thing, or think that they have done such operations safely when probably they were puncturing the bursæ only.

These bursæ mucosæ lie under the tendon of the extensor muscles, and under the ligament of the patella : they are of the same substance with the capsule of the joint itself; they lie over the capsule, united to it by cellular substance, and the bundles of fat, which are disposed irregularly about the joint, belong partly to the bursæ and partly to the capsule ; one end projecting into the cavity of the bursæ, while the other end of the same fatty bundles projects into the cavity of the joint.

Thus the knee-joint, which is the most important in all the body ; the most oppressed by the weight of the trunk, and by the accidental loads which we carry ; the most exercised in the common motions of the body, and the most liable to shocks and blows ; which is the most superficial and the weakest in all that respects its bones—is the strongest in its ligaments, and the most perfect in all the provisions for easy motion.

1. The great CAPSULE of the joint incloses the heads of the bone ; secretes (in part) and contains the synovia ; lines the joint with a smooth and delicate membrane, and, by turning over all the parts, and adhering to them, it forms the perichondrium for the cartilaginous heads of the bones, and the covering and ligaments for the moving cartilages of the joint.

2. This capsule, which is exquisitely thin, and which was formed for other uses than for giving strength to the joint, is surrounded on all sides with such continuations of the common fascia, and such particular expansions of the hamstring and other muscles, as by adding outwardly successive layers to the capsule, brings it to a considerable degree of strength.

3. The capsule having no stress upon its fore part, is very thin upon its fore part, viz. at the sides of the patella ; but is strengthened at the sides by fair and distinct ligaments, going from point to point of the three great bones: and so large and particular as to deserve, more than any others in the body, the name of LATERAL LIGAMENTS : at the back part of the joint the same strength is not required as at the sides ; yet it must be stronger than at its fore part, wherefore it is strengthened by the additional bands which are sometimes general and confused, but often so perfect and distinct as to be known by the name of the POSTERIOR LIGAMENT of WINSLOW ; and as the lateral ligaments prevent all lateral motions, this strengthening of the capsule serves as a check-band behind.

4. It is only in the greatest joints that we find the additional security of INTERNAL LIGAMENTS ; and the only joints where they are perfect are the joints of the hip and of the knee ; the former having its round, or rather triangular ligament, which secures the great ball of the thigh-bone, and fixes it in its place ; the latter having its crucial ligaments, which, coming both from one point nearly, and going the one over the face of the tibia, and the other down the back of that bone, serve the double purpose of binding the bones firmly together, and of checking the larger and dangerous motions of the joint ; the fore ligament preventing it going too far forwards, and the back ligament preventing it bending too much.

5. A MOVING CARTILAGE, for facilitating motion and lessening friction, is not common, but is peculiar to those joints whose motions are very frequent, or which move under a greater weight; such are the inner head of the clavicle, the articulation of the jaw, and the joints of the wrist and of the knee ; and it is in the knee that the moveable cartilages have their most perfect forms and use, are large and flat, semilunar, to correspond with the forms on the head of the tibia ; thicker at their outer edges, to deepen the socket : and though moveable, yet so tied with ligaments as never to go out from their right place.

And, 6. The mucous follicular bundles of fat, and the bursæ mucosæ, which complete the lubricating apparatus of the joint, and the mucous frenulæ or ligaments, which both conduct the mucous fringes and keep them in their place, are more perfect in the knee, and greater in number and size, than in any other joint.

I may well call this the most complicated, and (by daily and melancholy proofs) it is known to be the most delicate joint of the body.

FIBULA.

The FIBULA is a support to the tibia in its various accidents; it gives a broader origin to the muscles, and it is the chief defence of the ankle-joint. It has no motion upon the tibia; the best authors speak of it as a symphysis, which classes it with the joinings of the pelvis, and excludes it from the list of true and moveable joints. It is united with the tibia by a sort of flat cartilaginous surface upon either bone; it is merely laid upon the tibia, not sunk into it. It is tied by a close capsule: it has no particular ligament for itself; but is strengthened by the external lateral ligament of the knee, which adheres to this knob, and by the insertion of the biceps tendon, which is implanted into this point, and which spreads its expanded tendon over the fore part of the tibia, and holds the bones together; and the firmness of the fibula is further secured by the great interosseous ligament, which goes from bone to bone.

ANKLE.

The ANKLE-JOINT owes less of its strength to ligaments than to the particular forms of its bones; for while the strong lateral ligaments of the knee guard it so that it cannot be dislocated till they are torn, the lower heads of the tibia and fibula so guard the foot that it cannot be luxated sidewise without such violence as breaks these bones: first, the fibula is so connected with the tibia at its lower end, that they form together one cavity for receiving the astragalus, with two projecting points; the fibula forming the outer ankle, and the tibia forming the process of the inner ankle; the joining of the fibula to the tibia here, is like that of its upper end, too close to admit of the smallest motion; and it is thoroughly secured by particular ligaments; one of which passing from the fibula to the tibia on the fore part, is named the LIGAMENTUM SUPERIUS ANTICUM, consisting in general of one or two distinct flat bands. Another more continued and broader ligamentous membrane goes from the fibula to the tibia across the back part, and is named LIGAMENTUM POSTICUM SUPERIUS; the LIGAMENTUM POSTICUM INFERIUS being but a slip of the same. Next comes the capsule of the joint, which joins the astragalus to the lower heads of the tibia and the fibula; it is thinner both before and behind than we should expect from the strength of a joint which bears all the weight and the most violent motions of the body. But, in fact, the capsule everywhere serves other purposes than giving strength to the joint,

and never is strong except by additional ligaments from without; so it is with the ankle-joint, the capsule of which is exceedingly thin before, but it is strengthened at the back part, and especially at the sides, by supplementary ligaments: first, a strong ligament comes down from the acute point of the inner ankle, expands in a radiated form upon the general capsule; adheres to it, and strengthens it, and is fixed all along the sides of the astragalus: this ligament coming from one point, and expanding to be inserted into a long line, has a triangular form, whence it is named LIGAMENTUM DELTOIDES; and while the general ligament secures the joint towards that side, the oblique fibres of its fore edge prevent the foot being too much extended, as in leaping; and its oblique fibres on the back edge prevent its being too much bended, as in climbing; but the ligaments of the outer ankle, tying it to the other side of the astragalus, are indeed distinct, one going forwards, one going backwards, and one running directly downwards; one goes from the point or knob of the fibula, obliquely downwards and forwards, to be inserted into the side of the astragalus: it is square and flat, of considerable breadth and strength, and is called LIGAMENTUM FIBULÆ ANTERIUS. Another ligament goes perpendicularly downwards, from the acute point of the outer ankle, to spread upon the side of the astragalus and of the capsule, and is finally inserted into the heel-bone; this is named the LIGAMENTUM FIBULÆ PERPENDICULARE. A third ligament goes out still from the same point, to go backwards over the back part of the capsule; adheres to the back of the capsule, and strengthens it, and is named LIGAMENTUM INTER FIBULAM ET ASTRAGALUM, POSTERIUS. There is nothing very particularly worthy of notice in the ankle-joint; for it is covered with cartilages; lined with a soft and MUCOUS membrane; and lubricated with mucous fimbriæ and masses of fat, such as are found in all the joints. It is stronger than the other joints; it can hardly be luxated without a laceration of its ligaments, and breaking of the bones which guard it at either side; and it is the great violence which is required for completing this dislocation, and the terrible complication of dislocation, fracture, and laceration of the skin, which makes this accident so dangerous beyond any other luxation.

The ASTRAGALUS, OS CALIS, OS NAVICULARE, and all the bones of the tarsus, are united to each other by large heads and distinct and peculiar joints; besides which, the bones are cross tied to one another by ligaments so numerous and complicated that they cannot nor need not be explained. They pass across from bone to bone in an infinite variety of directions; some longitudinal; some transverse; and some oblique. There is

a curious complication, which we may call a web of ligaments, covering either side of the foot with shining and star-like bundles: each bone has its capsular ligament for joining it to the next; each joint of each bone has its articulating cartilages always fresh and lubricated; each joint has, besides its capsule, flat strips of oblique, longitudinal, and transverse ligaments, joining it to the nearest bones: and the greater bones have larger and more important ligaments, as from the astragalus to the os calcis, from the os calcis to the os naviculare, and from that again to the scaphoid bone, &c.

The metatarsal bones have their capsular ligaments joining them to the tarsal bones, and they have ligaments strengthening their capsules, and tying them more strongly to the tarsal bones; and, as in the metacarpal bones, the several ranks are tied one to another by cross ligaments, which pass from the root of one bone to the root of the next. We have ligaments of the same description and use, holding the metatarsal bones together, both on the upper and on the lower surface of the foot; and all the ligaments of the foot are of great strength and thickness. The lower ends of the metatarsal bones have also transverse ligaments by which they are tied to each other. The toes have hinge-joints, formed by capsules, and secured by lateral ligaments, as those of the fingers are; and except in the strength or number of ligaments, the joinings of the carpus, metacarpus, and fingers, exactly resemble the joinings of the tarsus, metatarsus, and toes.

But these ligaments, though helping to join the individual bones, could not have much effect in supporting the whole arch of the foot. It is further secured by a great ligament, which extends in one triangular and flat plate from the point of the heel to the roots of each toe. This is named the APONEUROSIS PLANTARIS PEDIS; which is not merely an aponeurosis for covering, defending, and supporting, the muscles of the foot; that might have been done on easier terms with a fascia, very slight compared with this; but the chief use of the plantar aponeurosis is to support the arch of the foot. It passes from point to point, like the bow-string betwixt the two horns of a bow, and, after leaping or hard walking, it is in the sole of the foot that we feel the straining and pain: so that, like the palmar aponeurosis, it supports the arch, gives origin to the short muscles of the toes, braces them in their action, and makes bridges under which the long tendons are allowed to pass; it comes off from the heel in one point; it grows broader in the same proportion as the sole of the foot grows broad; it is divided into three narrow heads, which make forks, and are inserted into the roots of the second, third, and fourth toes; and

the great toe and the little toe have two smaller or lateral aponeuroses, which cover their own particular muscles, and are implanted into the roots of the great toe and of the little toe.

The bursæ mucosæ surround the ankle and foot in great numbers. None of them having any very direct connection with the joint, and most of them accompanying the long tendons as they pass behind the ankle, or in the sole of the foot, are of that kind which we call tendinous sheaths. First, There are sheaths of two or three inches long, which surround the tendons of the tibialis posticus, and of the peronæi muscles, as they pass down behind the ankle. The sheaths of the peronæi begin from that point where the tendons first begin to rub against the bone, and are continued quite down into the sole of the foot; making first a common sheath for both tendons, and then a bursa peculiar to the tendons of the peronæus brevis muscle, and about an inch in length. Where the peronæus longus begins to pass under the sole of the foot, the sheath which inclosed it behind the ankle is shut, and a new bursa begins; in the same manner, where the tendons of the flexor pollicis and flexor digitorum pedis pass behind the inner ankle, a bursa of three inches in length surrounds them and facilitates the motion. As the tendons of the flexor muscles go under the arch of the foot, they lie among soft parts, and rub chiefly against the flesh of the massa carnea and the belly of the short flexor muscles: but whenever they touch the first joints of their toes, they once more rub against a hard bone. New bursæ are formed for the tendons. Each bursa is a distinct bag, running along the flat face of the toe, and is of a long shape, and the tendon is carried through the centre of the lubricated bag; so that we see once more that there is no true distinction betwixt bursæ mucosæ and tendinous sheaths, nor betwixt the tendinous sheaths and the capsules of joints.

Joints have been arranged under various forms, but not with much success; and I do not know that enumerating the joints in any particular order will either explain the motions of individual joints, or assist in recording their various forms; some joints are loose and free, capable of easy motions, but weak in proportion, and liable to be displaced; such is the JOINT of the SHOULDER, which rolls in every direction; other rolling joints, more limited in their motions, are better secured with ligaments of peculiar strength; such is the JOINT of the HIP, where the ligaments are of great strength both within and without: some, wanting all circular motions, are hinge-joints by the mere form of their bones; such are the LOWER JAW, the VERTEBRÆ, the ELBOW, and the ANKLE-JOINTS: some are hinges by their ligaments, which are then disposed only along the sides of the

bones ; such are the KNEE, the RIBS, the FINGERS, and the TOES. Some joints partake of either motion with all the freedom of a ball and a socket-joint, yet with the strength and security of the strictest hinge : thus the WRIST, having one joint by which its turning motions are performed, and another joint by which it rolls, has the two great endowments so rarely combined in any joint of the freest motion, and of great strength ; so also has the HEAD, by the combination of two joints of opposite uses and forms ; for its own condyles play like a mere hinge upon the atlas ; and the axis of the dentatus secures all the properties of a circular joint : this combination gives it all the motions of either joint without their peculiar defects. But there is still a third order of joints, which have such an obscure and shuffling motion that it cannot be observed. The CARPUS and METACARPUS, the TARSUS and METATARSUS, the TIBIA with the FIBULA, have these shuffling and almost immoveable joints ; they are not intended for much motion among themselves, but are appointed by a diffused and gradual yielding to facilitate the motions of other joints.

END OF THE FIRST VOLUME.

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Bell, J.
v.1
1812